Meteorites in Georgia

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Part 1. Nature and Value of Meteorites**

Introduction

A meteorite before entering our atmosphere has been for a very long time a non-luminous small solid object in space. It is interesting to speculate about where they were made and the mechanics by which they were made. Studies made on those that fall to earth show us that there is considerable similarity in their compositions and structures.

Occasionally one of these dark objects makes a spectacular display when it collides with our atmosphere to give us a fireball or shooting star. They enter our atmosphere at various speeds but always traveling very fast. They either explode, pass on through the atmosphere and vanish, or fall to the earth. Since the objects that strike the earth are different from our terrestrial rocks, it is possible to recognize them.

One of the chief purposes of this article is to encourage others to look for meteorites because they are important scientific specimens, and to cause the public to respect these important scientific specimens, which should be given or sold to institutions where meteorites are preserved and studied.

Meteorites are too important to be distributed in small lots in many different places. Those that are scattered in small collections are often neglected when investigations are being made, because the specimens are not accessible at the moment they are needed. Meteorites that are retained in private hands frequently become lost, or their historical records lost.

Investigators from many different sciences such as astronomy, chemistry, geology, metallurgy and physics, are turning their attention to the study of meteorites. These studies give us background knowledge about conditions which existed at the time meteorites were made, changes that have occurred since that time, and the relative abundance of elements outside our earth.

Although meteorites come to us from space they resemble the material which possibly occurs in the earth's interior. Thus the study of meteorites provides us with fundamental information about both this world and other planets.

Early peoples became interested in the spectacular displays made by falling meteorites, and in the objects that fell. Try to imagine what primitive man thought when suddenly he saw a brilliant meteorite flash through the sky. Those near enough to hear the noise a falling meteorite can make would be so scared that such an event would be retold by them for the rest of their lives.

Although there are legendary records about some old meteorite falls, as well as commemorative medals, sketches, etc., there are few specimens preserved that fell before 1500 A. D. At one time people looked upon heavenly bodies as the abodes of their Gods. During the centuries just before and after the birth of Christ it became the custom in certain lands to make commemorative medals about the fall of a meteorite.

The temples in which the celestial bodies were worshiped possibly contained some specimens that they believed fell; however, there is no proof that such specimens existed. Probably most of those samples were not meteorites. People then may have mistaken rocks for meteorites just as they do today. Nowadays the majority who try to recover the object they saw falling, select a terrestrial rock or some artificial product for the meteorite. Perhaps early peoples averaged no better in their recovery of true meteorites.

Anyone collecting meteorites appreciates the need of encouraging others to search for them. Thus it is desirable to have interested friends all over the country who will assist in getting these specimens. Anything as scientifically rare as

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The Lafayette, Tippecanoe County, Indiana Meteorite

This 600 gram stony meteorite was found near Lafayette, Indiana before 1931. Its date of fall is unknown but it is a recent fall. The scaled drawing on page 128 shows the dimensions of a cross section through this stone.

The dome-shaped forward face is covered with a black shiny crust about 0.1 millimeter thick. About the center of this face is the stagnation point where the least ablation took place. Many ridges radiate from this point and sweep down the sides to the edge. The ridges are glass, made from the fusion of the surface material of the meteorite. The ridges make a slight spiral as they extend down the side and the direction of these ridges indicates the meteorite was rotating on an axis passing through the stagnation point and perpendicular to the forward face. The rotation, however, was slow in comparison with the forward velocity of the meteorite.

The rear side is comparatively flat and covered with a fused crust about 1 millimeter thick. The glassy crust from the front side barely laps over onto the rear face. A narrow zone around the outside edge of this face contains a spattering of glassy blebs. This material was pushed off the front face by the air stream and was splashed on the rear face by the turbulent air in the wake of the falling meteorite.

The color of the crust on the back of most meteorites is different than the color of the crust on the forward side. Usually it shows a trace of brown. No appreciable degree of orientation exists in the fusion crust on the rear surface except towards the edges, where some of the dark blebs of glass have a limited degree of alignment in short rows.

Numerous small rounded cavities exist in the crust on the rear face and suggest that gas escaped as the fused material solidified. Air probably gets mixed into the molten glass on the front because the hot moving air that pushes the molten material along is so tightly pressed against the front surface that it mechanically mixes air into the molten material. The crust accumulates on the rear face either by direct melting or spattering of fused material from the forward side. The molten material that is spattered onto the rear looses its air bubbles because immediately behind the meteorite there is an area of low pressure.

Both the Cabin Creek and the Lafayette meteorite entered our atmosphere at high velocities. They lost material by vaporization and ablation, also projecting pieces are possibly mechanically torn off. Thus, the mass is being sculptured in flight and reduced to a streamlined and rounded object. Once the object assumes a stabilized position it will continue in that position until it either breaks apart or strikes the earth.

Within a few seconds after entering our atmosphere meteorites loose their high velocity and reach a point where their surface is being cooled rather than heated. Most meteorites, and probably all the small ones, strike the earth with so little force that almost no damage is done to the meteorite.

Meteoritic iron is relatively soft and may be easily scarred by a light blow of a hammer. Yet many large iron meteorites show no detectable damage traceable to impact with the ground. Some meteorites are composed of poorly-bonded aggregates of minerals, and although when recovered they show fractures, impact with the ground failed to shatter them.

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**A second installment of this article will describe the falls reported from Georgia.

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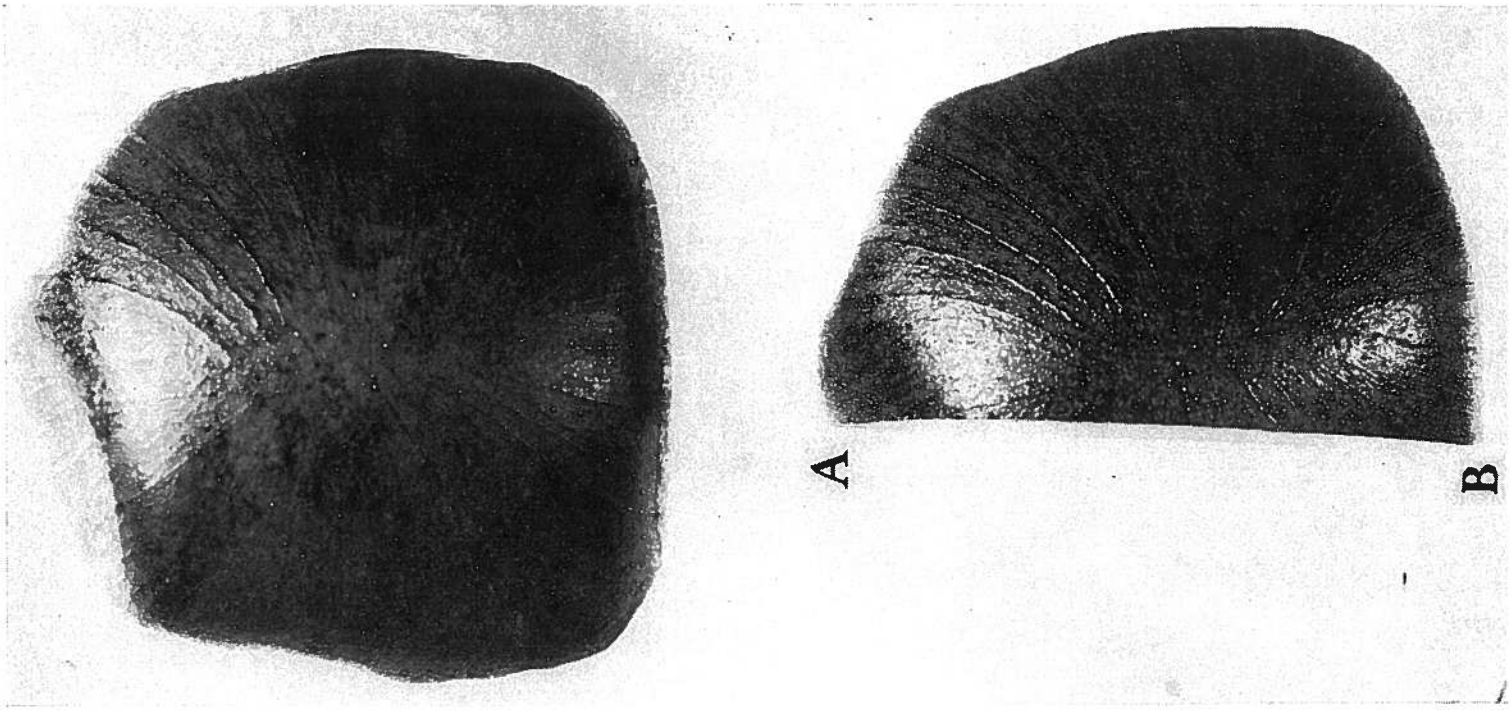
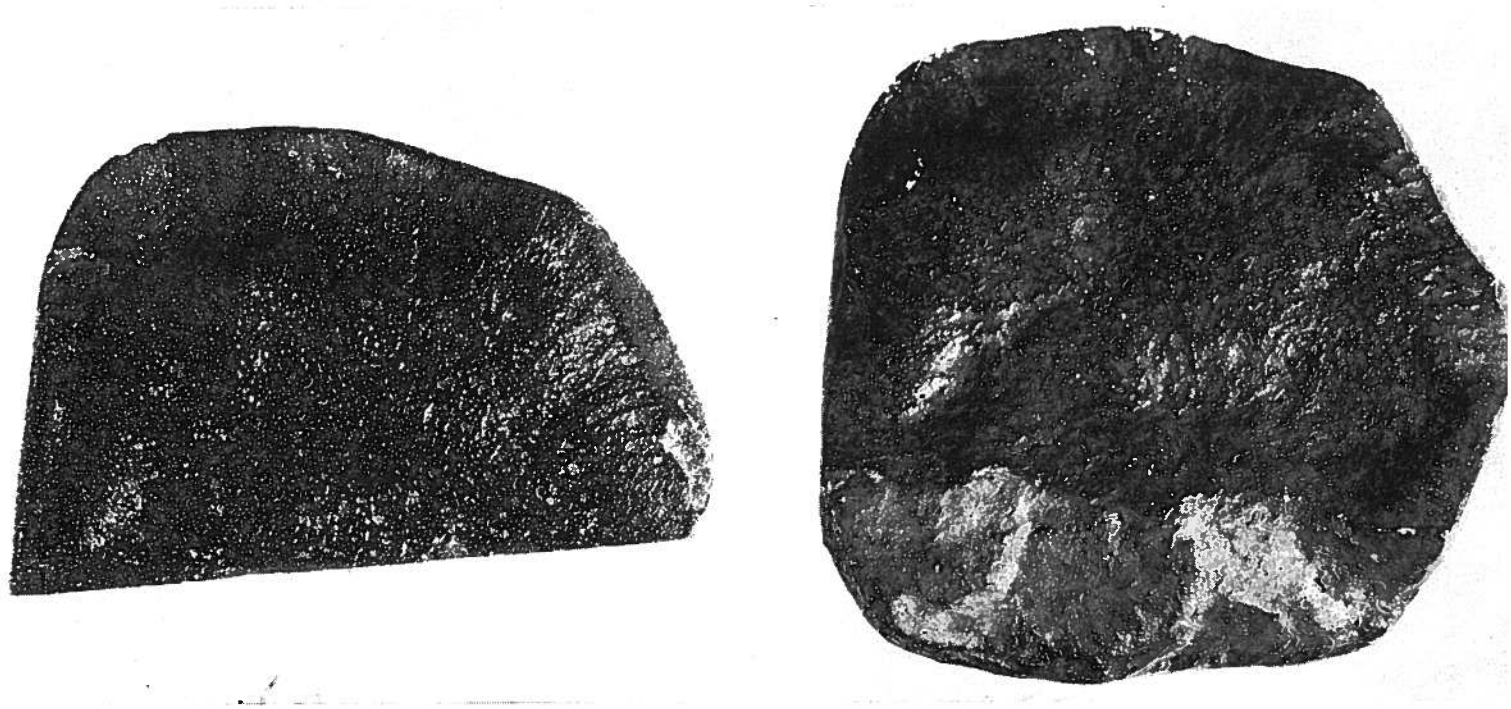


Front Face.



Rear Face.

The Lafayette Indiana Meteorite

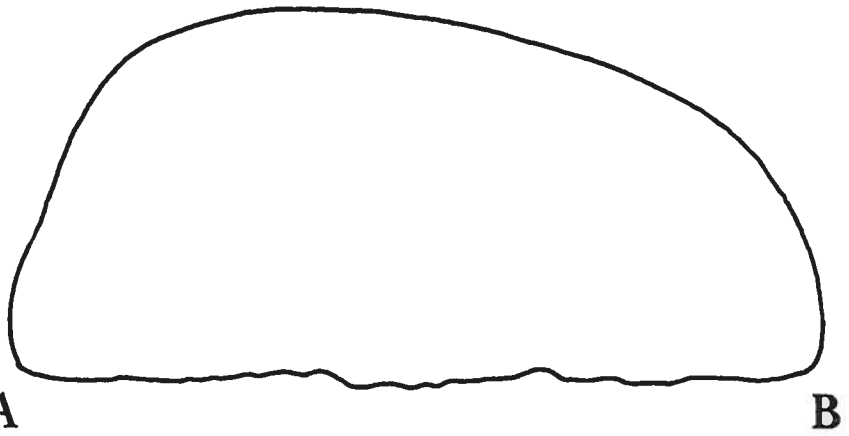
a meteorite should not be mistreated or find its way into household cabinets where miscellaneous things are retained only for a while. Meteorites in private collections often get misplaced or discarded after the death of the owner.

Investigators in most natural history sciences can go into the field to collect the specimens they need, but the growth of a meteorite collection depends upon the interest of others. To stimulate more interest in these objects most museums will purchase meteorites. We want to encourage more people to assist in this work by showing them how to recognize a meteorite.

Distribution and Times of Meteorite Falls Between 1800 and 1950

A meteorite may fall any place and at any time. There is no reason why anyplace would be a preferred target, yet the present information on the distribution of observed falls shows some areas have been hit more frequently than others. Me-

teorite statistics are far from satisfactory because the nature of the terrain sometimes makes it difficult to observe meteorite falls, and all people are not equally interested in reporting the recovery of a witnessed fall. Most of our information about falls and finds comes from areas within the northern hemisphere. There, from November to March, the hours between sundown and sunrise are cool, thus for most of the years between 1800 and 1950 fewer people were in a position to observe meteorite falls. Now that many trained observers are stationed at airfields and, airplanes are flying throughout the night, our meteoritic records should improve.



A scaled drawing of the cross section through the Lafayette Indiana meteorite from A—B.

More meteorites are recovered from certain areas because of (1) the nature of the terrain, (2) the population density, (3) people have been encouraged to look for meteorites. To illustrate the known distribution of meteorites, three areas within our country were selected, each with approximately the same number of square miles and the meteorites reported from each area as well as the number of witnessed falls of meteorites within the area, are given.

Table 1

The number of known meteorites and the observed meteoritic falls from three areas in the United States.

	Area in Square Miles	*Known Meteorites*	*Number of Witnessed Falls*
	Area 1		
Tennessee	44,022	22	3
North Carolina	52,426	30	9
Mississippi	46,865	3	2
Alabama	51,998	14	6
Georgia	59,265	19	3
South Carolina	30,989	6	2
	285,565	94	25
	Area 2		
Kentucky	40,598	21	3
Virginia	42,627	11	3
West Virginia	24,170	2	0
Maryland	12,327	4	2
Indiana	56,147	10	2
Ohio	41,047	10	2
Pennsylvania	45,126	8	3
Delaware	2,370	0	0
New Jersey	8,224	1	1
	272,636	67	16
	Area 3		
Kansas	82,158	72	6
Missouri	69,420	15	5
Nebraska	77,520	31	1
Iowa	56,147	5	4
	285,245	123	16

Although the above districts have essentially the same area, there is considerable variation in the number of meteorites reported from each. The total of the known meteorites are 94, 67 and 123 while the observed falls for the same areas are 25, 16 and 16 respectively. These figures give some information about the distribution of meteorites within our country but a different set of values would be obtained if areas of corresponding size were selected from other parts of our country. Still greater differences would occur if one of the areas selected was from Asia, South America or Africa for obvious reasons.

An inspection of the listings of the dates on which meteorites fell shows that something unusual happened in Alabama, not only once but twice. The event most readers recall is the meteorite which fell November 30, 1954 at Sylacauga, Alabama. This one made history when it crashed through the roof of a house, bounced off some furniture and struck Mrs. Ann Elizabeth Hodges who was resting on a couch. Although Mrs. Hodges was not hit directly she became famous in a way few want to gain fame, because she was the first person known to have been hit by a meteorite falling from space. The Sylacauga fall made the kind of news that gets world-wide circulation and is an event that will be retold many times.

The other unusual event which happened in Alabama concerns two meteorites which fell in 1868. Neither one by itself was unusual, but it so happened that 8 days after a 4½ pound stone fell at Danville, Morgan County, on November 27, (J. L. Smith, 1870) a second meteorite fell at Frankfort, Franklin County, on December 5th (G. F. Brush, 1869). The second one fell within fifty miles of the first, and weighed 1¾ pounds. Probably it is only a coincidence for witnessed falls to occur within so few miles of each other and within such a short time. Apparently this is the only case on record where two witnessed meteorites came so close to hitting the same spot.

Another interesting relationship between the time and place of fall took place in Russia. The meteorite which fell in the woods near Tunguska, Siberia, June 30, 1908 at 12:16 A.M., is one of the major meteoritic events of recent times. We can be thankful that such things do not happen often. But another four-pound meteorite fell within six hours and fifty-four minutes of the Tunguska fall at Kagarlyk, 2,750 miles away.

The timing of these Russian and Alabama falls prompted a further inquiry into meteoritic falls to learn (1) the number of witnessed falls, (2) number of falls occurring on the same day, (3) the number that were seen within each month.

Our survey includes 627 witnessed meteoritic falls, and in all but 24 cases the data seem definite enough to be assigned to a particular day. The falls for which the data are somewhat indefinite are recorded in a separate column.

Table 2 lists the total witnessed falls for each month for a period of 150 years, and also the falls for which the year is probably correct but the month in which the fall occurred is not well established.

Farrington, (1915) reported 331 witnessed meteoritic falls between 1800 and 1901* Leonard, (1941) reported 582 witnessed falls between 1790 and 1940. The survey just completed shows 627 witnessed falls between 1800 and 1950.

The survey of witnessed meteoritic falls, here reported, does

*The figure at the end of Farrington's table incorrectly gives a total of 350.

not always agree with that of Leonard's of 1941. The difference can only be resolved by checking the original data. Hey's catalogue (1953) was the source of the information for this survey. Those in which the month and day were not reported are here called indefinite, but Leonard, reporting witnessed falls by the year, included such falls in his count. However, there are other differences between the two surveys which can not be explained in this way. The extent of the differences is shown by the fact that 48 of the 139 years covered in the two surveys are not in agreement.

Our survey shows that no meteoritic falls were reported in 1800, 1802, 1809, 1816, 1831, 1832 and 1888. In 1930 and 1933 there were 13 and 12 falls reported respectively. The next largest number was reported in 1868 when 11 falls were seen.

The difference between our survey and those of Farrington or Leonard does not materially change the relative distribution of monthly falls. Probably the number of falls reported in our survey between 1800 and 1935 are less likely to change than the years since 1935, because often a lag occurs between the observation and the time the information is published. It is doubtful if more witnessed falls will be reported for the years 1800 to 1935.

Table 2

Witnessed meteorite falls from 1800 through 1950.
Reported by the month and the year in which the fall occurred.

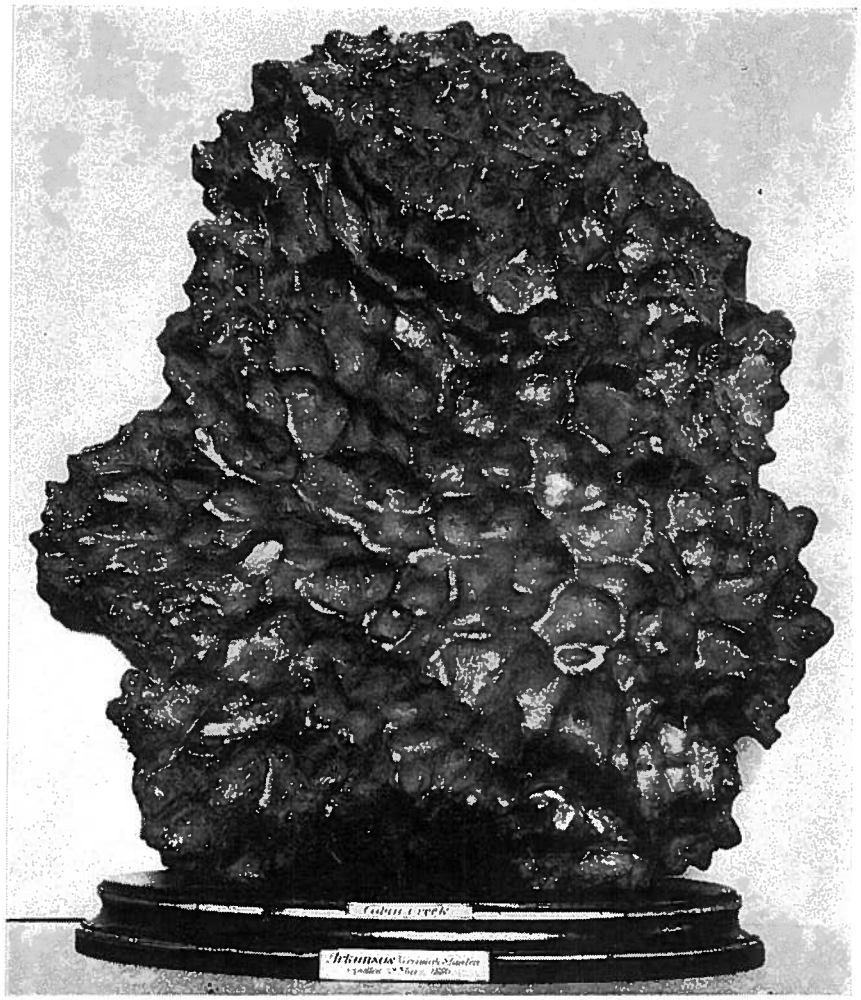
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	INDEF.	TOTAL[1]
1800														0
1801												1		1
1802														0
1803				1						1		1		3
1804				1							1			2
1805				1										1
1806			1											1
1807			1									1		2
1808				1	1				1				1	3
1809														0
1810	1							1			1			3
1811			1				1				1			3
1812				2				1	1					4
1813									1			1		2
1814		1							1		1			3
1815		1								1				2
1816														0
1817												1		1
1818				1		1		1						3
1819						1				1				2
1820							1							1
1821						1								1
1822						2		1	1		1		1	5
1823								1					1	1
1824	1	1								1				3
1825		1							1					2
1826					1			1						2
1827		1			1					1				3
1828						1								1
1829					1			1	1					3
1830		1			2				1					4
1831														0
1832														0
1833											1			1
1834						1								1
1835							1	1						2
1836	1					1			1		1			4
1837							2	1						3
1838	1			1			1			1				4
1839		1												1
1840					1	1	1							3
1841			1			1					1			3
1842				1		1	1				1			4
1843			1			2			2		1			6
1844	1			1						1				3
1845	1						1							2
1846					1			1				1		3
1847		1					1							2
1848		1			1		1					1		4
1849										1				1
1850						1					1			2
1851				1							1			2
1852	1								1	1		1		4
1853		1	2											3
1854									1					1
1855					2	2		1						5
1856								1			1			2
1857		1	1	2						2		1		7
1858					1			1				2		4
1859			1	1	1			1						4
1860		1	1		1	1	1						1	5
1861					2	1								3
1862											1	1		2
1863				1			1		2				2	6
1864					1	1	1							3
1865	1			1		1			3	1				7
1866					1	2	2				1		1	7
1867						1	1							3
1868	1	1	1			1	1	1		1	1	1	2	1 11
1869	2					2				1	1			6
1870	1							1	1					3
1871						1	1						1	1 3
1872						1	1	1	1					4
1873							2			2				1 4
1874						2						1		3
1875		1		2	1				1	1				6
1876		1			1		2						1	5
1877	2					1	1					2		6
1878							1	1	1	1		1		1 5
1879	1		1			2	1			1		1		1 7
1880		1				1							2	4
1881			1				1					1		2 3
1882		1	1						2					4
1883	1	1									1			3
1884		1	1			1								3
1885					1				1			1		3
1886	1		1			2				1	1			1 6
1887	2				1				1	2				6
1888														0
1889					1		1	2					1	5
1890		1			1	1	3	1						7
1891					1					1				2
1892						1		1	1					3
1893		1			1	1				1				4
1894					1	2		1						4
1895					1	2							1	3
1896		2			2									4
1897						1	1		3	1	1		1	7
1898	1								2		1			4
1899	1		1					1		1	1		1	5
1900						1	2	2	1					6
1901		1					1				1	1		4
1902							1	1	1	1		2	1	6
1903	1				1		2	1			1			6
1904					2	1			1		1			5
1905	1				1	1				1	1			5
1906			1			1	1					2	1	6
1907	1	1				1				1		1		5
1908			1	1			2					1	1	6
1909						1			1					2
1910	2								1		2	1	1	1 7
1911	1						2				1			4
1912					1		1	1	1					4
1913	1				2									3
1914					2	1		2			1			6
1915	1						1							2
1916	1				3	1		2			1	1		9
1917		1			1			3					1	6
1918	1	1				1	1			1	1			6
1919					1	1	1		1		1			5
1920	1							1	2	1			1	6
1921	1				2	1	1		1		1		1	8
1922	1	1			1			1						4
1923			1	1							1		1	3
1924			1			2	2	1	1	1	1			9
1925		1			1	1	1	1	2	1			1	8
1926					1	1	1						2	5
1927					2	2	1	1					1	1 7
1928					1		1		1	1	1	1		6
1929		2	1					1			1		1	5
1930		1	1	2	2			1		4	1	1		13
1931				1		1	1	1						4
1932				1	1			1	2			1	1	7
1933	2	1	1	1				2	2		2		1	12
1934			2			1	1			1		1	2	1 8
1935			1	1	1			4		1				8
1936				1	1			1	1	1				5
1937					1					2			1	4
1938	1	1	1			1	3			1	1		1	10
1939				1	1	2	1	1	1				1	8
1940				1			1				1		1	4
1941									2					1 2
1942					1					2	1			4
1943									1			1		2
1944		1	1			1	1			1	1			6
1945		1								1				2
1946	1					1			1					3
1947	1	2											1	4
1948		1												1
1949	2						1			3			1	6
1950					1	1					2			4

Table 3

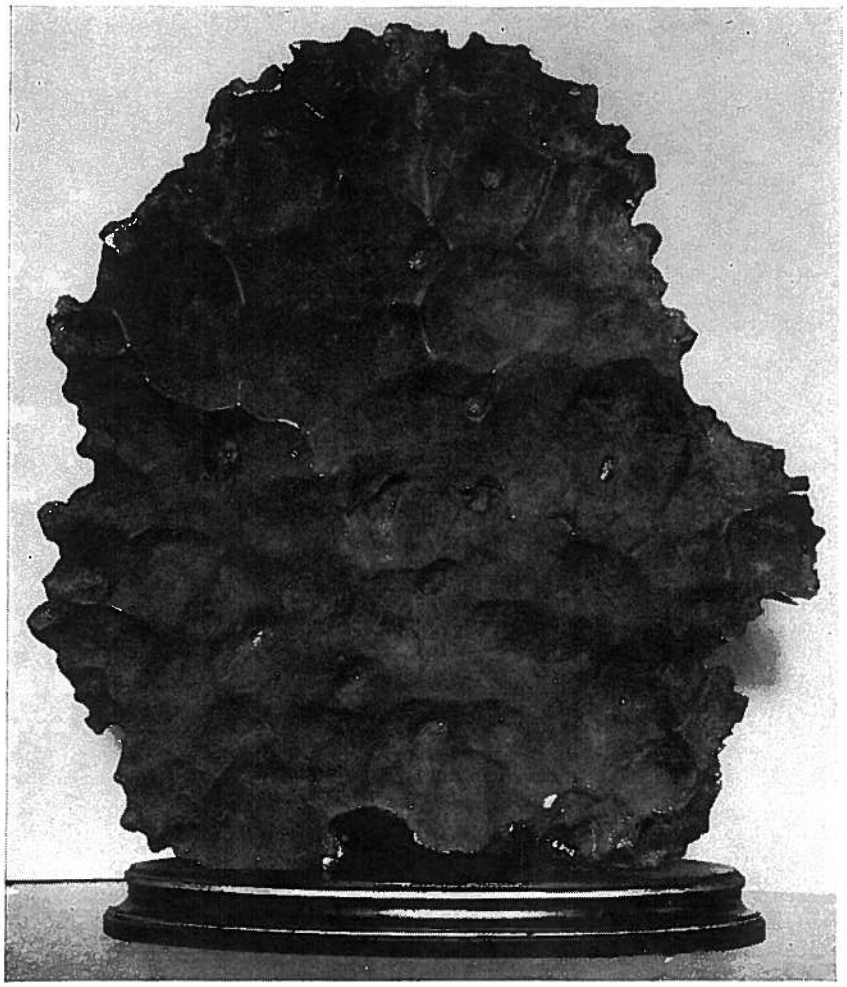
Meteorites which fell between 1800-1950 according to the month in which the fall occurred.

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	INDEF.	TOTAL
42	39	34	62	69	71	58	55	56	42	37	38	24	627

[1]Exclusive of the indefinite.



Front of Cabin Creek.



Rear of Cabin Creek.

Cabin Creek Arkansas Meteorite.

Table 4

The years between 1800-1950 in which five or more meteorites were seen to fall. The number represents those with acceptable data, the number enclosed by ( ) are witnessed falls for which the month and day are not well established.

Year	Number	Year	Number	Year	Number
1822	5	1890	7	1921	8
1843	6	1897	7 (1)	1924	9
1855	5	1899	5 (1)	1925	8 (1)
1857	7	1900	6	1926	5
1860	5 (1)	1902	6 (1)	1927	7 (1)
1863	6	1903	6	1928	6
1865	7	1904	5	1929	5 (1)
1866	7	1905	5	1930	13
1868	11 (1)	1906	6	1932	7
1869	6	1907	5	1933	12
1875	6	1908	6	1934	8
1876	5	1910	7 (1)	1935	8
1877	6	1914	6	1936	5
1878	5 (1)	1916	9	1938	10
1879	7 (1)	1917	6	1939	8
1886	6 (1)	1918	6	1944	6
1887	6	1919	5	1949	6 (1)
1889	5	1920	6		

Five or more witnessed falls occurred in 53 of the 150 years covered in Table 2. But 62 percent of these 53 years are within the last fifty years. This could mean two things; (1) meteorites are falling more frequently; or (2) the population is larger and the public is taking more interest in meteorites, thus the records are more complete. The second possibility is more logical.

In some years an unusually large number of witnessed falls are reported. The years with the greatest number are 1930, 1933 and 1868 when 13, 12 and 11 falls respectively, were reported. In 1938, 10 were seen to fall and 9 were witnessed in both 1916 and 1924.

From January 1, 1930 to December 31, 1939 there were 72 observed falls, including one for which the month is not definitely known. This is the maximum number of witnessed falls for any 10 year period between 1800 and 1950. However, 44 of the 72, or 61 percent of the falls occurred between January 1930 and December 31, 1934, during the "Depression" when many people worked outside.

Witnessed falls are reported for every year since 1888. In only seven of the 150 years were no witnessed falls reported. With the exception of 1888 the years when no falls were reported all are in the early part of the 19th century, when little attention was given to meteorites. Thus, it seems that we can expect a few observed falls each year. The average for the 150 years is 4 falls per year.

On some days two meteorite falls have occurred. These cases are listed in Table 5. Falls, which occur on the same day, may or may not be related to each other. This point has not been fully investigated. The two English falls of 1806 are doubtful, as no samples were preserved. The Korean falls of 1930 apparently represent two names assigned to the same meteorite.

Table 5

Meteorites which fell between 1800 and 1950 within about a day of each other.

YEAR	DAY	MONTH	METEORITE	COUNTRY	TYPE OF METEORITE
1806	17	May	Glastonbury	England	None recovered
1806	17	May	Basingstoke	England	None recovered
(Both are doubtful meteorites as no specimens were preserved)					
1865	25	August	Shergotty	India	Sherghottite
1865	25	August	Aumale	Algeria	Chondrite
1908	30	June	Tunguska	Russia	Nothing recovered
1908	30	June	Kagarlyk	Russia	Chondrite
1925	28	August	Lanzenkirchen	Austria	Chondrite
1925	28	August	Ellemeet	Holland	Rhodite
1927	27	August	Sopot	Rumania	Chondrite
1927	28	August	Aba	Japan	Stone
1930	17	March	Gyokukei	Korea	Chondrite
1930	17	March	Zindoo	Korea	Stone
(possibly two names representing one meteorite)					
1933	8	August	Sioux County	Nebraska, U.S.	Howardite
1933	8	August	Repeeve Khutor	Russia	Octahedrite

According to the records, almost as many iron meteorites are known as stony ones but most of the iron are discoveries. Witnessed falls are predominantly stones, while most of the iron meteorites have been discovered after they fell. Thus one can assume there must be hundreds of unrecognized stony meteorites on or near the surface of the earth. A much higher percentage of the metallic meteorites is recovered because they are easier to recognize.

Out of the 627 falls witnessed between 1800 and 1950 only 27 are irons. The limited number of irons that have been observed to fall becomes more interesting when one notes that Hey (1953) shows that 683 meteorites out of a total of nearly 1700 known meteorites were seen to fall.

Of the observed falls the ratio is about 25 stones to 1 iron. Hey (1953) reports about 550 known iron meteorites, of which possibly 10 percent may be paired with another iron. If 25 stones fell for each iron there should be from 10 to 12 thousand stony meteorites, but Hey lists only 810, of which an appreciable percentage may be paired falls. Evidence indicates that there should be quantities of stony meteorites awaiting discovery, especially in arid climates where conditions for their preservation are better. The fact that about 800 stony

The Cabin Creek, Arkansas Meteorite

The forward face of the 107 lb. iron which fell March 1886 near Cabin Creek, Johnson Co. Arkansas. The wide but shallow depressions are called thumbmarks and are a common feature of meteorites. This front face is covered with a black fused crust of variable thickness. On the rims around these depressions the crust is thinner than it is within the depressions. The silvery gray color of the nickel iron often shows through the crust along rims and the center of the front face on iron meteorites.

The rear face differs in many ways from the front. It is covered by a fusion crust but the texture of the crust is different than it is on the forward face. The fused crust often accumulates at the edge of the rear face of the meteorite. The depressions in the aft side generally are wider and shallower than those on the front surface, but these deeper cavities here shown may be related to inclusions in the meteorite which were more easily ablated than the metal.

The shape of this meteorite shows that it held a fixed position during flight. Possibly it tumbled for a while after it entered the atmosphere and before it attained a stabilized position.

The rear surface of many meteorites is flat and on this side the thumbmarks, crust and delicate structures are distinctly different from those on the forward side. Perhaps many meteorites have a flat surface when they enter our atmosphere but the feature may represent fractures from a break or explosion in our atmosphere. Again flat surfaces could be a fracture made in the primordial body, from whence these smaller objects came.

The temperature of the front face of a meteorite probably is considerably higher than that of the aft face during its fall through the air. As the heat softens the surface, metal is swept off the front side. The delicate hair-like lines we can see in the fused crust show the direction of the air flow.

Since there is less ablation from the rear face of an orientated meteorite, heat may penetrate the iron deeper here than it does on the forward face. The greatest loss of material takes place on the front side and ablation may remove iron too fast for heat to penetrate very far. However, the rear face has a thicker accumulation of crust than the front and this may serve as an insulating blanket or thermal barrier against the penetration of heat into the metal. Possibly if it were not for the formation of the thin layer of oxide on the front surface of an iron falling through out atmosphere, even more metal would be lost.

The few deep cavities on the rear face of this iron could have formed shortly after the meteorite entered our atmosphere and before the mass attained a stabilized position.

The Cabin Creek meteorite is displayed in the K. K. Naturhistorischen Hofmuseums, Vienna, Austria.

←

Magnification about ⅓ natural size

meteorites are known whereas possibly there should be 10 thousand, presents a challenge to the discoverer.

The statement is frequently made in discussions that there is no relationship between meteorite falls and the reoccurring meteor showers, the Perseides in August or the Leonids in November.

What Meteorites Look Like

Only the features of the common types of meteorites can be discussed here. If the specimen seen to fall or suspected of being a meteorite, does not conform to these features, and is not similar to the local rocks, have it investigated by someone who knows meteorites.

Most meteorites are comparatively small, irregular rounded objects. Some are essentially stony, others are made entirely of metal and a few contain a considerable proportion of both stone and metal. Meteorites are never abundant any place, and since they are different from the rocks of this earth they can be recognized. It is desirable to have any unusual specimen examined regardless of whether or not it is suspected of being a meteorite.

A freshly fallen meteorite usually is covered with a thin black crust, because most meteorites contain iron and only a trace of iron is needed to darken the fused crust. After a meteorite falls it begins to react with oxygen and water and the fusion crust slowly turns brown. Usually as soon as a brown color is conspicuous in the crust, rusty areas occur around any metallic inclusions near the outside of the meteorite.

The fusion crust on an iron meteorite is more firmly attached than the crust on a stony meteorite. The crust on newly fallen irons is black but it also slowly turns brown. Often an old rusty iron is fresh and unaltered only a fraction of an inch below its surface. The alteration products more or less insulate it against further alteration. Metallic iron is dense, impervious and generally alters slowly. Some irons are difficult to preserve and those containing chlorides will usually alter rapidly, especially if stored in a humid atmosphere. The final alteration product of meteoritic iron is strong magnetic. Occasionally an iron alters in such a way that the secondary products retain much of the original structure of the meteorite.

An examination of the flight crust sometimes shows how the meteorite was orientated during its fall. A meteorite is moving so fast when it enters our atmosphere that it develops a high temperature on the front by colliding with the air. Furthermore, the hot air accumulates since the meteorite is moving faster than the air can escape. Air is pushed along the sides of the body and this flow of hot air melts and ablates material from the surface. Although some molten material sticks on the surface most of it is pushed along by the air.

As the velocity of a meteorite is reduced by friction with the air, its surface temperature decreases and finally a point is reached where the molten material freezes. When this happens the ripples in the fused material are preserved. The direction of these delicate lines or "flight markings" indicates the orientation of the object.

The high temperature and mechanical ablation on the front of the meteorite reduces its size by melting, and while protruding irregularities, especially on the edges may be torn off. Some of the internal fractures which extend to the front face, may fail and the object will appear to explode. It frequently happens that meteorites break in the air and several pieces fall. Thousands of individuals have been known to fall in a meteoritic shower. When a meteorite makes a spectacular display it is common for several masses to fall. Probably all the pieces will not be recovered, and there is no way of knowing what proportion of the total fall is recovered.

The falling meteorite is losing weight and entering denser atmosphere, and soon a point is passed where the ratio between weight and area of exposed surface cause the velocity of the meteorite to decrease rapidly. Now the surface is being cooled rather than heated. Thus, a small meteorite is not hot when it strikes the earth. Also there is not enough energy released in the collision of the meteorite with the earth to develop any appreciable heat.

From the above discussion it is evident that a meteorite cannot have a thick glassy coat on its surface. Thus no meteorite will resemble a furnace slag.

Sometimes the color of the unaltered fusion crust on a stony meteorite will be white because the meteorite contains very little iron. The Cumberland Falls, Kentucky (G. P. Merrill, 1920) and the Pena Blanca Springs, Texas (J. T. Lonsdale, 1947) are such meteorites. The Bishopville, S. Carolina (C. U. Shepard, 1848) has a very unusual crust and in places its minerals fused to a clear glass. However, this clear colorless glass is best seen when the surface is examined under a binocular microscope.

Thus color of the fusion crust is not a dependable criterion to use in identifying a meteorite. If one only looked for specimens with dark colored crusts he would fail to detect some of the rarer, highly prized varieties.

There is not much variation in the appearance of the flight crusts of freshly fallen irons. Some of the melted material from the front face may get spattered onto the aft side but not every meteorite is orientated as it falls, so some do not show this feature. Now and then some of the molten material is forced into cracks, but the injected material rarely penetrates far.

Narrow dark glassy veins are common in stony meteorites and often can be seen in areas where the crust is broken off. These veins were in place before the meteorite entered our atmosphere. Although veins filled with fused material occur around the outside of some of the iron meteorites, these cannot be seen until a polished surface is examined with a lens.

A few surface features are somewhat peculiar to meteorites.

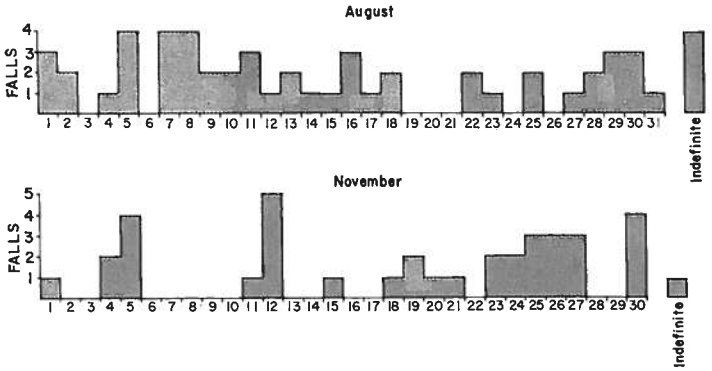


Figure 1. Witnessed meteoritic falls between 1800-1950 according to the date on which the fall occurred.

Possibly the most common is the wide, shallow depression called "Thumbmarks", because of their resemblance to an impression made by a thumb. These are more numerous in irons but also occur in stones. Occasionally some auger-like holes occur in iron meteorites.

The interior of most meteorites show little evidence of having been reheated since they originally cooled. Evidence indicates that they cooled millions of years before entering our atmosphere. Some, however, do appear to have been reheated.

The delicate markings in the fused crust, the nature of the depressions, and the shape of the main mass are useful guides in identifying most meteorites. However, it is necessary to study the nature and composition of the interior of some specimens, particularly the altered irons, to be certain they are meteoritic.

Most meteorites are dense, heavy objects. When your curiosity is aroused about a specimen, compare its weight with a rock of almost equal size. If it proves to be heavy carry the investigation further. However, there are a few meteorites that are not excessively heavy. Speaking as one who has examined thousands of supposed meteorites, it would eliminate much unnecessary work if people would apply this simple test to the specimens they think may be meteorites.

A type of stony meteorite which has a low density is the black, rather crumbly stones containing considerable carbon, *carbonaceous chondrites.** The lowest density one author (EPH) ever found on any piece from a stony meteorite was a small portion of the Murray, Kentucky stone (J. R. Horn, 1953). This fragment, which may not be typical of the entire meteorite, has a density of 2.86. Such a density is less than that of many of the common terrestrial rocks, so obviously such a meteorite would not be recognized by its excessive weight.

Shapes of Meteorites

There is considerable variation in the shapes of meteorites, yet there are a few general features. Usually a freshly-fallen meteorite is an irregularly-rounded object and looks like it was sculptured in a blast of hot air. On weathering they lose this appearance. A surprising number of meteorites have rather flat sides. These flat surfaces generally are the rear face but this side is not flat like a break along bedding planes in a shale. Meteorites are not bedded materials so the flat sides represent fractures or cleavage breaks.

Thus meteorites with flat sides may be fragments of a larger body which separated along a fracture during its flight in our atmosphere. Also fractures might have formed when the meteorite was in its primordial body. One type of iron, the hexahedrite[1] has a good cleavage, and in some cases will have a rather flat surface. The Boguslavko, (E. L. Krinov) 1946 obviously separated in flight along its cleavage, because two fragments of it were found which fit together.

Generally the newly made surfaces which occur when meteorites break in flight are covered with a fusion crust. But in some cases these newly made surfaces are not as uniformly or as heavily crusted over as the rest of the meteorite. The fact that the new surface is partly covered with a fused crust shows the meteorite failed or exploded while traveling very fast.

Hexahedrites have a tendency to separate along the cleavage directions as they alter. Thus such an iron after long exposure may have a jagged surface. The Smithonia, Georgia, iron (S. K. Roy and R. W. Wyant, 1950) when found had a surface that was quite different from the average altered iron meteorite.

Some altered *stony meteorites* spall more or less parallel to the shape of the specimen. Occasionally an iron of the *hexahedrite* or *coarse octahedrite*** type, with large grains, will separate along the grain boundaries as they weather, hence their weathered surface may be irregular. Thus the surface of an altered meteorite may be very different from a newly fallen meteorite. The shape of a meteorite is a useful feature but it is not an entirely reliable criterion for identification.

Although the object entering our atmosphere may be quite irregular, the mass soon orientates itself in the air into a stabile position. A few meteorites have a conical form which we assume resulted from a fixed position during their flight. Probably the best known of the conical meteorites is the largest iron from this country, the Willamette, Oregon meteorite (H. A. Ward 1904).

How to Identify a Metorite

If you think a specimen is a meteorite take a few minutes to look at the surrounding rocks. Note their surfaces, break off the corners of some to expose a fresh area, and examine the fresh surface critically. Compare the features of the surrounding rocks with those of the unknown specimen. Remember that meteorites are never abundant at any one place. Compare the weight of the unknown, or a piece broken from it, with a piece of rock of the same size. If the unknown is not heavy for its size, and is similar to many of the local rocks it probably is not a meteorite.

If the specimen is a stone, look for these features:

(1) The presence of fused crust on the surface.

(2) Small metallic inclusions which may be detected by a magnet, or by rubbing the fingers over a fresh break, in which case the metallic inclusions will feel jagged.

(3) Metallic inclusions enclosing round silicate bodies.

(4) Small rounded silicate bodies or chondrules.

(5) Thin black veins within the specimen.

If the specimen is metallic, look for these features:

(1) Is the object magnetic? All iron meteorites are strongly magnetic.

(2) Is the iron malleable? The magnetic terrestrial minerals are brittle but meteoritic iron is malleable.

(3) Remove the surface film from a small spot and note the color of the metal. Meteoritic iron is gray, similar to the color of a five cent coin.

(4) Tap the object with something; metallic meteorites give a different sound than rock.

(5) Is the specimen particularly heavy for its size?

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*Chondrites are stony meteorites in which chondrules or rounded grains (spherules) are present. Carbonaceous varieties contain quantities of carbon.

[1]Iron meteorites usually show intergrowths of kamacite and taenite, two nickel-iron alloys. Hexahedrites, however, consist of only one alloy, kamacite, and etched polished surfaces will show prominent striae, called Neumann lines.

**Octahedrites contain kamacite and taenite and their etched surfaces exhibit an octahedral pattern which also is called a Widmanstatten pattern.

What to Do if You Find a Meteorite

The U. S. National Museum, Washington 25, D. C. will be glad to examine and report on specimens believed to be meteorites, or if the discovery is made in Georgia, the Department of Mines, Mining and Geology, 19 Hunter Street, S. W., Atlanta 3, Ga., will also examine and advise the sender about the samples.

If the suspected meteorite is small, send it to either institution. If it is large, remove a small piece and have a preliminary test made on that portion. If the sample tested proves to be a meteorite and is important, very likely an offer will be made to purchase the main mass.

Those who find a meteorite are urged to see that it is not damaged. Please apply no reagents to it. Newly fallen meteorites should be kept as free from terrestrial contamination as possible. It may be necessary to remove a small piece for a preliminary test, but do not scar the sample unnecessarily. Many meteorites have been so badly damaged that much of their value was lost.

A meteorite contains nothing that can be recovered and sold for a profit. Meteorites are scientific specimens and their only value is in the information they contain. They may tell us something about the history of another world, about the interior of our own world, the relative abundance of the elements, etc. but they have no intrinsic value. To evaluate a meteorite one usually considers it's importance to science as well as the collection to which it may be added. The policy at the U. S. National Museum is to estimate the value of the meteorite by considering several factors, hence this institution has no fixed price for meteorites.

Most collectors of meteorites arrive at the value of a specimen by considering the following factors:

(1) Size. Some meteorites are so large that it is impracticable to move them from where they fell, and some are so small that it is impracticable to divide them. Therefore, size is one of the most important factors. The Hobo, Southwest Africa (L. J. Spencer, 1930), the Mbosi, Tanganika (D. R. Granthan and F. Oats, 1931) and the Bacuberito, Mexico (H. A. Ward, 1902) are such heavy specimens that they lie where they fell. Their estimated weights are 60, 25, and 27 tons respectively.

A meteorite weighing between 100 and 200 lbs. usually can be moved, is large enough to be sliced without detracting from the importance of the specimen, can be conveniently handled in the laboratory when studied, and slices may be cut from it without expensive mechanical equipment.

It is important to cut slices from a meteorite because these can be studied and some may be exchanged for slices of meteorites not represented in the collection. But a small and unusual meteorite should not be sliced; hence it increases the prestige of a collection because it can never become widely distributed.

(2) Type. This has been partly discussed under size, so it is only necessary to mention this feature because it is well known that unusual specimens are worth more than common ones. If a small meteorite belongs to one of the common types and is without special features it has little value. But if it is an unusual type, the value may be considerable.

(3) Degree of Preservation. This is something that is more important to the buyer than the seller. All meteorites are not equally stable; thus collectors usually offer less for one which will disintegrate than they will offer for one that is stable. These unstable meteorites are difficult to preserve and present problems to the collectors.

(4) Unusual Features. If a meteorite has some unusual features such as, flight markings, interesting inclusions, numerous cavities, or is a witnessed fall the bids are usually increased to reward the finder for the additional features or information.

(5) Witnessed Falls and First Finds. Collectors usually show a decided preference for witnessed falls, specially important new falls. The first piece discovered generally brings a higher price than samples of the same fall found years later. As more material is found it usually follows that the meteorite is more widely distributed in collections, hence the price decreases. Also pieces discovered many years after the first sample was found may be badly weathered. Thus from several points of view it is less desirable.

Sometimes the one who sells a meteorite later discovers that meteorites occasionally bring several dollars a pound. If the seller got less for his specimen he may think that he did not get full value. That party may not realize the time, effort and money that is spent on a meteorite after it is purchased. To cut, polish and etch slices, to photograph, study and describe the meteorite costs money, so naturally the prepared and studied specimens are worth more per pound.

An iron meteorite is a difficult object to cut and polish. Expensive saws are needed and other equipment is required to polish the slices. The cost of the equipment and the operators time should be considered in estimating cutting costs.

Considerable quantity of a meteorite is lost in the cutting. Although the thickness of the slice may be only 3/8 inch, the channel made by the band saw will measure about 1/8 inch. So percentage-wise there is considerable loss which must be reckoned with in estimating costs.

Today many people have a hobby of cutting rocks and these folks could cut a stony meteorite but few persons are equipped to section an iron meteorite. If the finder of a stony meteorite gives it to a person who has no experience with meteorites it may be sliced in such a way that considerable of its value is lost. The form and external features of the meteorite may be worth preservation, thus sections cut in an undesirable direction through a meteorite may seriously detract from its value.

It is unlikely that the curator of a large collection will purchase a meteorite if the price is unreasonable. He realizes that someday perhaps another meteorite will be found with almost these same features so it is better to refuse to pay excessive prices and use that money to buy other specimens.

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Meteorites in Georgia

Part 2: Description of Falls

by

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INTRODUCTION

Although only 21 meteorites are known from Georgia, these few display a sufficient variety of types and mode of discovery to give those who are familiar with them an excellent background in meteorites.

The first witnessed meteorite fall in our country happened in 1807, and the first fall to be observed in Georgia occurred in 1829. In the following table there are listed the five first witnessed falls in America but since the Caswell, North Carolina, stone was lost, the *Forsyth meteorite is the fourth witnessed fall in our country.*

Table 1: The First Witnessed Meteoritic falls in the United States.

NAME	STATE	YEAR	MONTH	DATE	WEIGHT
Weston	Connecticut	1807	Dec.	14	150 kgs.
Caswell	North Carolina	1810	Jan.	30	1.36 kgs.
Nobleboro	Maine	1823	Aug.	7	2 to 3 kgs.
Nanjemoy	Maryland	1825	Feb.	10	7.5 kgs.
Forsyth	Georgia	1829	May	8	16 kgs.

Two of the meteorites listed from Georgia, Aragon and Elberton, may be known by other names. Two newly discovered irons are reported here for the first time, Twin City and Pulaski County.

If the Aragon and Elberton meteorites are omitted from the Georgia falls, as it appears they should be, there are only 14 irons, 4 stony and one intermediate type, the Pitts meteorite. Four of these meteorites, the Forsyth, Lumpkin, Pitts, and Thomson are witnessed falls.

A Georgia meteorite might be one of the oldest falls that has thus far been found. Reasonably good evidence indicates that the Sardis iron fell in a former geologic period; however, this cannot be proven beyond all doubts. Whenever an extensively weathered meteorite is discovered close to the surface of the earth it is assumed to be an old fall, but it is not, necessarily, as old as the beds in which it was buried.

Likewise a meteorite with well defined flight marking and with no apparent alteration is assumed to be a comparatively recent fall. Any meteorite that remains buried in the ground for many years, in our southeastern states, undergoes considerable alteration. The rate of weathering more or less depends upon the chemical and physical nature of the meteorite as well as the ground in which it is buried.

Perhaps, the Sardis iron fell in Miocene times when the sediments, from which it was recovered, were accumulating. If true, it was wet with sea water and buried in unconsolidated sediments. In such an environment it would be encrusted with an alteration film, then blanketed with fine sediments. Also, the meteorite would have been protected by a deficiency of oxygen. Such a spot might be ideal for the preservation of a meteorite.

When these sediments were elevated above sea water level, the chemical nature of their environment changed. Erosion eventually brought the meteorite into the zone of oxidation where ground waters near the surface usually are acid. Possibly an iron, buried for scores of years within the zone of oxidation, could look as old as one that fell when the Miocene sediments, in which the Sardis iron was found, were accumulating.

The importance of the Sardis iron is based not only upon the possibility that it fell in Miocene times, about 20 million years ago, but because it is the largest meteorite thus far found in any of the southeastern states.

Occasionally a meteorite strikes our earth with enough force to make an impact crater but usually meteorites are so retarded in their fall that they neither seriously deface themselves nor penetrate the ground very far. Only limited amounts of meteorites have been found within the large meteorite craters. There is no evidence to suggest that the Sardis iron rebounded from any nearby depression and tumbled to the place where it was found.

The Georgia meteorites are discussed alphabetically and in an accompanying table the known weights and the counties in which they either fell or were discovered and the coordinates of their general localities are given. A map gives the geographical distribution of the Georgia meteorites and each fall is indicated by the number which appears in the first column of the table also in the heading to each chapter. Since the Argon (1) and Elberton (5) are assumed to be known by other names these numbers do not appear on the map.

Each separate chapter contains a table listing most of the collections where specimens of these meteorites are available for examination and all reproducable pictures of these meteorites that are available are here republished.

Thus far, all of the discovered witnessed meteorite falls in Georgia have occurred in the northwestern part of the state. The Pitts meteorite is the only one that was found south of the thirty-second parallel, which enters the west side of Georgia in the southern portion of Stewart County and runs eastward to a point a few miles south of Savannah. The Pitts meteorite, however, fell just a few miles south of the thirty-second parallel.

Note: This article is published with permission of the Secretary of the Smithsonian Institution. Part 1 of this study was published in the Georgia Mineral Newsletter, Vol. IX, No. 4, Winter 1956, pp. 126-135. A glossary of terms is included at the end of the article.

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No meteorite has been found to the east or south of a diagonal line originating at Pitts, in Wilcox County, extending in a northeasterly direction to Twin City, Emanuel County, then, to the northeastern part of Jenkins County where the Sardis iron was found.

Meteorites are conspicuously absent from most of the Coastal Plain and in the southeastern part of the state; probably because this section is sparsely populated and much of it is pine woods. With 19 meteorite discoveries within the part of the state outlined above one would expect there should be almost as many undiscovered meteorites in the sections of Georgia from which no finds have been reported.

It is regrettable that those who discover meteorites do not have more respect for value because many meteorites suffer abuse from their finders—in fact some of the Georgia meteorites were deliberately broken up. When this happens a large percentage of the sample is often lost before it is studied. Almost 25 percent of the Georgia meteorites were mutilated before they were studied, and the whereabouts of significant portions of other falls seem to have been lost.

Four of the meteorites from Georgia were discovered by plowmen. Since modern agricultural implements no longer require the farmer to trudge behind the plow, in intimate contact with the soil, fewer meteorites will be located in this manner.

Georgia, unlike most of our states has four iron meteorites to every stony meteorite and if one neglects witnessed falls the statistics become even more interesting. Fourteen irons were discovered while only one stony meteorite was found.

The abundance of the different types of iron meteorites, based essentially upon chemistry, is given in the following table:

Table 2: Types of Iron Meteorites in Georgia

	Octahedrites			
Hexahedrite	Coarse	Medium	Fine	Ataxite
3 Cedartown	2 Canton	4 Dalton	15 Putnam	?0 Twin City
7 Holland's Store	11 Paulding Co.	9 Losttown		
8 Locust Grove	14 Pulaski Co.	18 Social Circle		
17 Smithonia	16 Sardis			
	21 Union Co.			

When the distribution of these types of iron meteorites is studied (see attached map) many of these localities are not far apart and possibly some of these irons should be regarded as paired falls.

The four stony meteorites, Forsyth (6), Lumpkin (10), Pickens County (12) and the Thomson (19) are chondrites.

The Pitts (13) is classified as an intermediate type.

Table 3: Georgia meteorites.

Name	*Weight*	*County*	*Latitude*	*Longitude*
1 Aragon	5 grams	Polk	34° 1′	85° 3′
2 Canton	7 kilograms	Cherokee	34° 12′	84° 30′
3 Cedartown	11 kilograms	Polk	34° 0′	85° 16′
4 Dalton	59 kilograms	Whitfield	34° 57′	84° 52′
5 Elberton		Elbert		
6 Forsyth	16 kilograms	Monroe	33° 0′	83° 55′
7 Holland's Store	12 kilograms	Chattooga	34° 21′	85° 23′
8 Locust Grove	11 kilograms	Henry	33° 20′	84° 8′
9 Losttown	3 kilograms	Cherokee	34° 10′	84° 30′
10 Lumpkin	357 grams	Stewart	32° 3′	84° 59′
11 Paulding County	725 grams		34° 0′	84° 50′
12 Pickens County	400 grams		34° 30′	84° 30′
13 Pitts	3.7 kilograms	Wilcox	31° 55′	83° 36′
14 Pulaski County	116 grams		32° 15′	83° 30′
15 Putnam County	32.5 kilograms		33° 20′	83° 20′
16 Sardis	800 kilograms	Jenkins	32° 57′	81° 52′
17 Smithonia	70 kilograms	Oglethorpe	34° 0′	83° 11′
18 Social Circle	99 kilograms	Walton	33° 40′	83° 44′
19 Thomson	234 grams	McDuffie	33° 25′	82° 29′
20 Twin City		Emanuel	32° 35′	82° 01′
21 Union County	7 kilograms		34° 52′	83° 55′

Note: Although meteorites are conventionally located by latitude and longitude for the benefit of those who are not familiar with local geography, in many cases those coordinates merely locate the town near which the object was found and not the actual discovery point which may be miles removed from that locality.

Descriptions of the meteorites from Georgia

1. Aragon, Polk County

All that is known about the Aragon meteorite is an entry in Farrington's 1916 catalog of the collection in the Field Museum of Natural History. It was discovered in 1898 and consists of two oxidized fragments weighing five grams. Apparently, the Chicago Museum neither acquired more of this iron nor related their fragments to another meteorite.

Farrington, 1916, classified the Aragon meteorite as a nickel-poor-ataxite. Possibly, the samples he had were a portion of the Cedartown meteorite, which also came from Polk County, and was an oxidized iron when discovered in 1898. Although Farrington classified it as a nickel-poor-ataxite and the Cedartown is a hexahedrite, this difference does not preclude them from being pieces off the same iron. If the Aragon fragments were obtained from the outside zone of the Cedartown iron the structures could be similar to a nickel-poor-ataxite.

The metal around the outside of some hexahedrites lacks both the Neumann lines and the orderly structure of hexahedrites. This is because the metal near the surface of some hexahedrites has undergone some thermal changes which give these zones a similar structure to the nickel-poor-ataxites. Only the sections which cut deep enough into the meteorite to get the metal from below the granulated zone will show the true nature of that meteorite. When the first section was cut from the Smithonia, Georgia, meteorite it was classified as a nickel-poor-ataxite but subsequent sections that were made through this meteorite showed well developed Neumann lines. (See section 17 which deals with the Smithonia meteorite).

2. Canton, Cherokee County

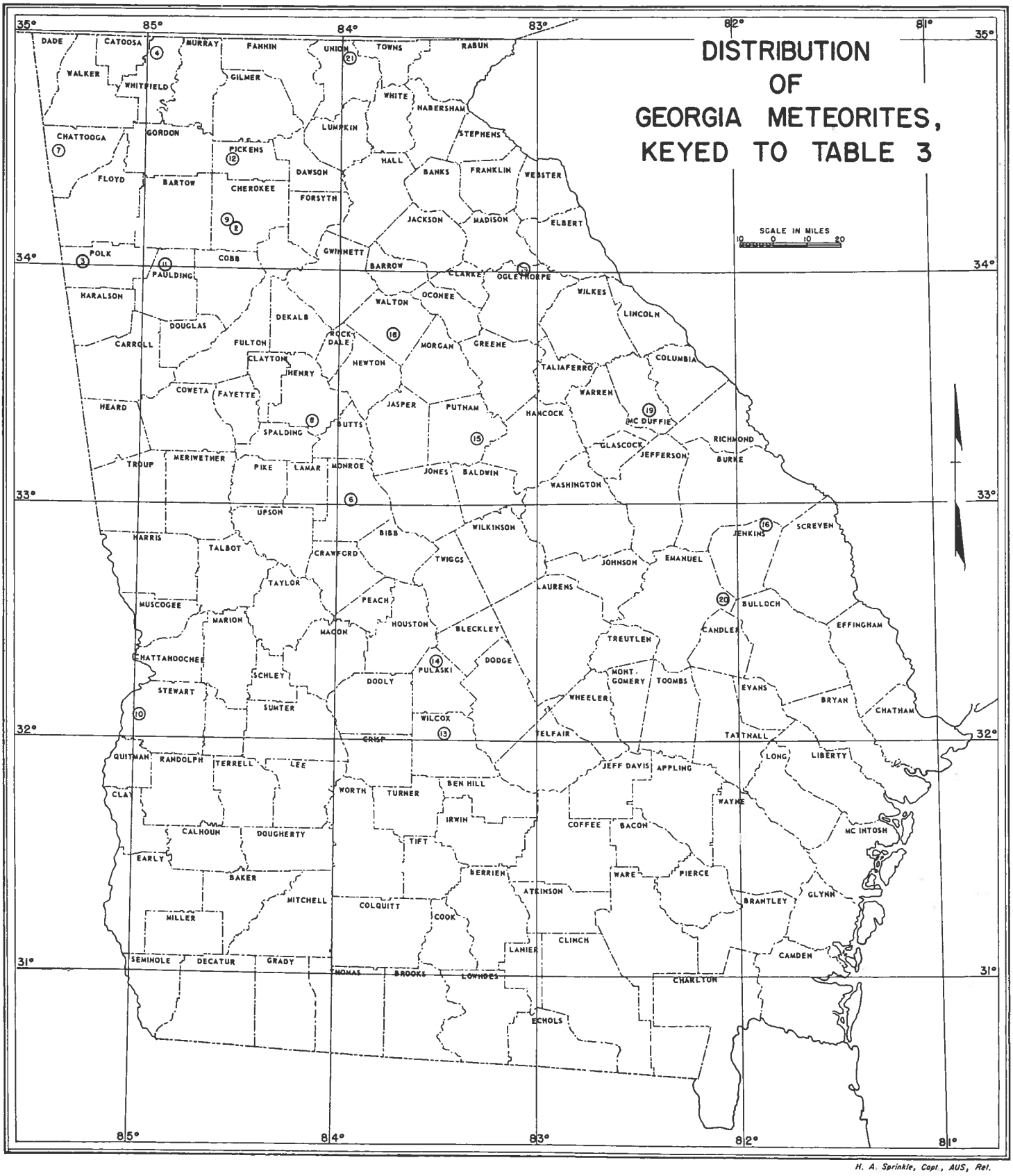
This iron, according to Howell and Stokes, 1895, is a coarse octahedrite. It was found in 1894 a few hundred yards from the Clarkson gold mine, which then was about five miles southwest of Canton.

This 15.5 pound iron was partly exposed when discovered by a plowman who was breaking new ground. Unfortunately, this meteorite was badly abused by its finders; sometimes those who are fortunate enough to discover a meteorite subject the specimen to heat tests, cut them apart, drill holes into them and beat on them with hammers until their surfaces are badly battered. Such treatment destroys important physical features and makes the meteorite less valuable. The Canton iron not only was mutilated but about half of its mass was lost because today only 8.5 of the original 15 pounds can be accounted for.

Two octahedrites are known from Cherokee County, the Canton and the Losttown irons. The etched patterns of the Losttown iron (shown in Section 9 of this study), is not identical with the Canton iron, however, neither iron has been studied in detail. The only specimens we have compared are those in the U. S. National Museum. The Canton iron contains less plessite than the Losttown but the width of the kamacite lamellae in the two meteorites are similar. The average for the Canton iron is 1.18 millimeters and the average for the Losttown measures 1.1 millimeters. However, the widths of the kamacite depends upon the direction the cut goes through the structures so these comparisons are not of much importance.

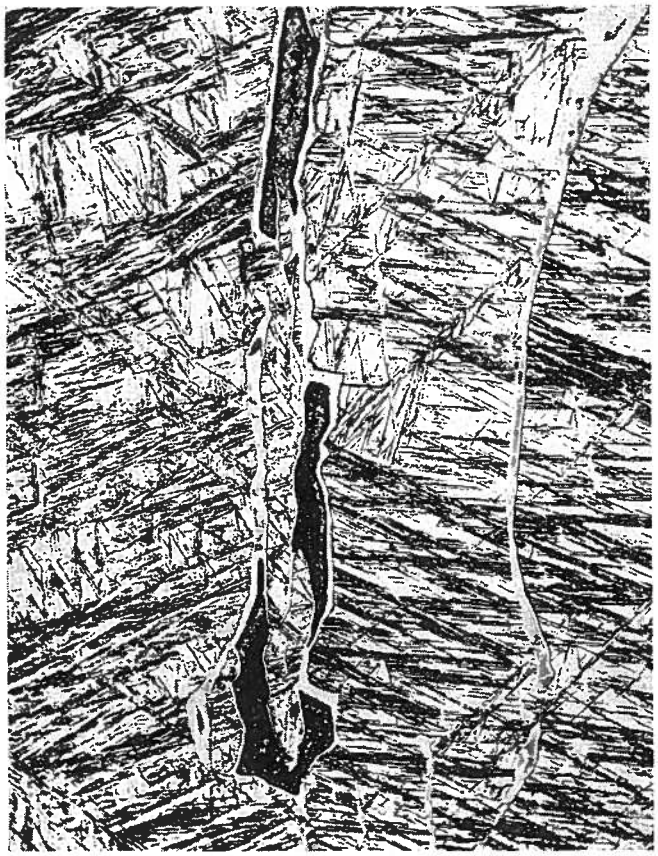
The chemical analysis of the Canton iron, as reported by Howell and Stokes:

Fe	*Ni*	*Co*	*Cu*	*P*	*S*	*C*	*Analyst*
91.96	6.70	0.50	0.03	0.11	0.01	Trace	Stokes



Map showing distribution of meteorites in Georgia.

A



B

A. Many of the kamacite lamellae in the Canton iron have no taenite bands along their edges and are not as sharply defined as the kamacite lamellae usually are in most irons. Possibly, this meteorite, after the kamacite had formed, was reheated and quickly cooled. Natural size.

B. A narrow taenite band and an elongated dark plessite band separate the kamacite in the central part from the kamacite areas to the left and right side. The kamacite in the central part of this picture and in the lamella to the left has a similar orientation but the alinement of the acicular grains in the area to the right is different. The acicular habit possibly means quick cooling during the transformation temperatures. 100x

The kamacite in the accompanying illustrations of this meteorite displays a well developed acicular structure, which signifies rapid cooling in the temperature range where the kamacite transformed. The kamacite in many meteorites is a homogeneous crystalline material containing one or more sets of Neumann lines which are enclosed by a thin band of taenite. However, the kamacite in the Canton iron is different. Thus, this iron has a history different from the meteorites with normal kamacite lamellae.

Troilite in these illustrations is also surrounded by acicular kamacite which extends to the edges of the sulfide body. Usually, troilite is enclosed by narrow zones of swathing kamacite which chemically and physically is different from the kamacite in the matrix. There is no swathing kamacite around the troilite in the accompanying picture. The numerous small black inclusions dispersed through the sulfide probably are carbon.

The Widmanstatten structures in the Canton iron indicate that it probably was cooling slowly when the kamacite lamellae formed. Possibly, at first, the taenite bands enclosed the kamacite, swathing kamacite occurred around the troilite, and the carbon may have been segregated at the edge of the troilite or concentrated within them. We assume these conditions existed because they apparently explain the structures commonly found in most iron meteorites.

The internal structures in the illustrations of the Canton iron show that its early history probably was similar to that which we have outlined, but possibly the Canton iron was reheated. The temperature to which it was raised is not known because it could either be a high temperature for a short duration or a comparatively low temperature for a long period of time. The last condition seems to be the most reasonable assumption. The acicular structure in the kamacite indicates the reheating was followed by rapid cooling.

According to Vogel, 1945, if troilite is heated above 980° C. it shows a granular structure. It is possible to assume that the scattering of the carbon through this troilite represents granulation. The structure shown in the Canton iron was not made during its flight through our atmosphere, and it is not the structure that forms when a meteorite is heated by man.

Samples of the Canton meteorite are deposited in the following collections:

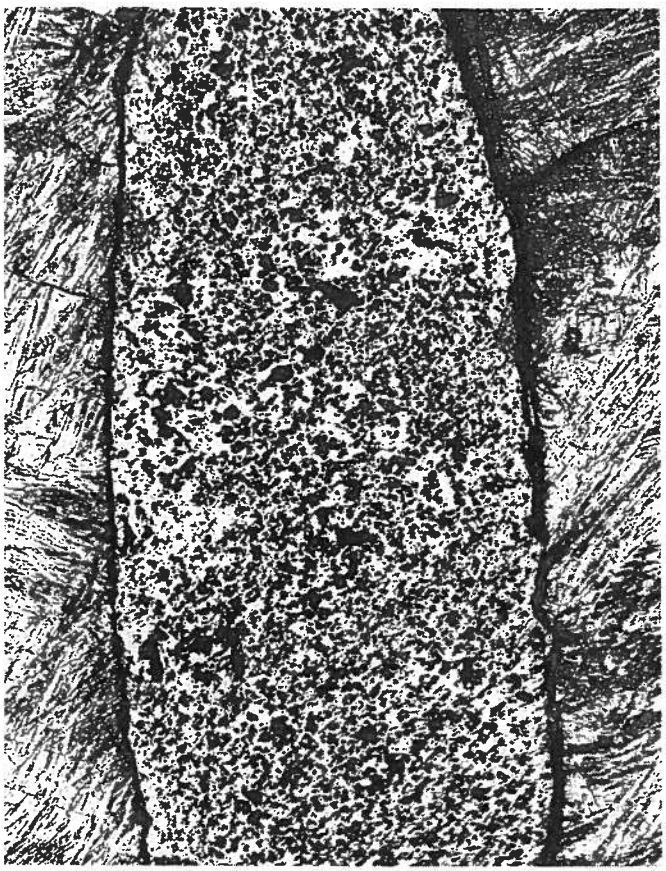
U. S. National Museum	416 grams	Washington, D. C.
American Museum of Natural History	36 grams	New York, N. Y.
Chicago Museum of Natural History	268 grams	Chicago, Illinois
Mineralogical Museum, Harvard University	122 grams	Cambridge, Mass.
British Museum (natural history)	329 grams	London, England
Yale University	82 grams	New Haven, Conn.

References

Howell, E. E. and Stokes, H. N. 1895 On two new meteorites: The Cherokee Meteorite, the El Capitan Meteorite. Amer. Journal Sci., v. 50, 251-54.

Vogel, R. 1945 Uber Troilite, Chemie der Erde, v. 15, 4th part. 371-387.

C



D

C. Two kamacite lamellae separated by a light colored band, which although similar to kamacite bands at the sides, contains small clear taenite bodies which are normal to the edges of the central area. The structure directly below the dark plessite at the top of the central zone is intermediate between that of kamacite and of a typical plessite area. These acicular kamacite lamellae do not have taenite bands at their edges. 100x.

D. The acicular kamacite extends to the border of the troilite. This troilite lacks the usual band of swathing kamacite around it. The dark inclusions within the troilite are presumed to be carbon. 50x

3. Cedartown, Polk County

This hexahedrite was known before 1898 and was a rusty mass when found in a newly plowed field between Cedartown and Cave Springs in Polk County. It came into the possession of S. W. McCallie, State Geologist of Georgia about 1898. McCallie must have had some notes about its history but his records were destroyed when his house burned.

The McCallie residence, in Atlanta, was a frame building and the meteorite was in a room on the second floor at the time of the fire. This eight room building, which had no basement, burned to the ground within an hour and the meteorite was later recovered from the ashes. Since the specimen measured 9 by 11 inches and weighed 25½ pounds, it could not have escaped from being surrounded with considerable heat. It is interesting to note that the heating neither destroyed the Neumann lines nor any of the characteristic features of the hexahedrite.

The shape of the Cedartown specimen resembles a slab torn from a larger object. All its existing surfaces are the products of corrosion and no trace of any of the original flight surface could be found. Iron meteorites usually have broad shallow depressions called thumbmarks on their surfaces but if such depressions were present on the Cedartown iron they were removed by corrosion. So considerable metal may have been lost by weathering.

A significant feature about this specimen is the system of fractures. The accompanying picture shows a crack that is about 7 millimeters wide on one face, extending for several centimeters beyond the open crack. Two smaller fractures are present on the opposite face of this iron and all lie more or less at right angles to each other. Since, the Cedartown iron is a hexahedrite, and such meteorites may separate along their cubical directions, these features may be parallel to the cleavage directions in the meteorite.

However, these cracks could have formed when this piece was torn from some larger mass or, when it separated from its parent body. But there are at least two other possibilities. Meteorites do separate in flight. Also several of the weathered hexahedrites show a tendency to separate along cleavage directions and coarse octahedrites separate along their grain boundaries so these fractures in the Cedartown could be due to weathering.

Some of the hydrated iron oxide from the large crack has a layered structure similar to the alteration products on the surfaces of some of the extensively weathered irons.

The Cedartown specimen is not more than 8 centimeters thick, so, if the larger fracture was extended very far, this iron would separate into two rather similarly shaped pieces. A fracture, similar but much larger, occurs in the Bacubirito iron from Mexico, a model of which is displayed in the U. S. National Museum. If the fracture in that iron was extended it would have separated the Bacubirito iron into similar

shaped masses. However, the last named meteorite is a fine octahedrite so its fractures could not be due to a cleavage weakness.

Perry, 1946, in discussing the metallography of the Cedartown iron called attention to some of the unusual features in the accompanying pictures. His comments about the structures shown in the picture of lower magnification are, ". . . two systems of parallel but irregular bands crossing the surface, their directions differing by about 15 degrees. This appearance is due to elongated grains of more or less uniform width, suggesting the columnar pattern of grains produced by certain heat treatments in artificial irons. These grains tend to group themselves in irregular bands which are conspicuous to the eye on an etched surface because their sheen is oriented differently from that of the adjoining grains."

Composition of the Cedartown, Georgia Meteorite.

	Fe	*Ni*	*Co*	*P*	*S*	*Cr*	*Analyst*
1	94.02	5.48	0.22	0.30	0.04	0.02	Henderson
2		5.48	0.53				Goldberg and others
3	93.63	5.48	0.53	0.30	0.04	0.03	Calculated analysis

Since analysis number 1 was published, Goldberg and others, 1951, found hexahedrites usually contained about 0.50 percent nickel so their value was taken as correct. From analysis number 1 and 2 the calculated composition of this meteorite is given in analysis 3.

Specimens of the Cedartown iron are in the following collections:

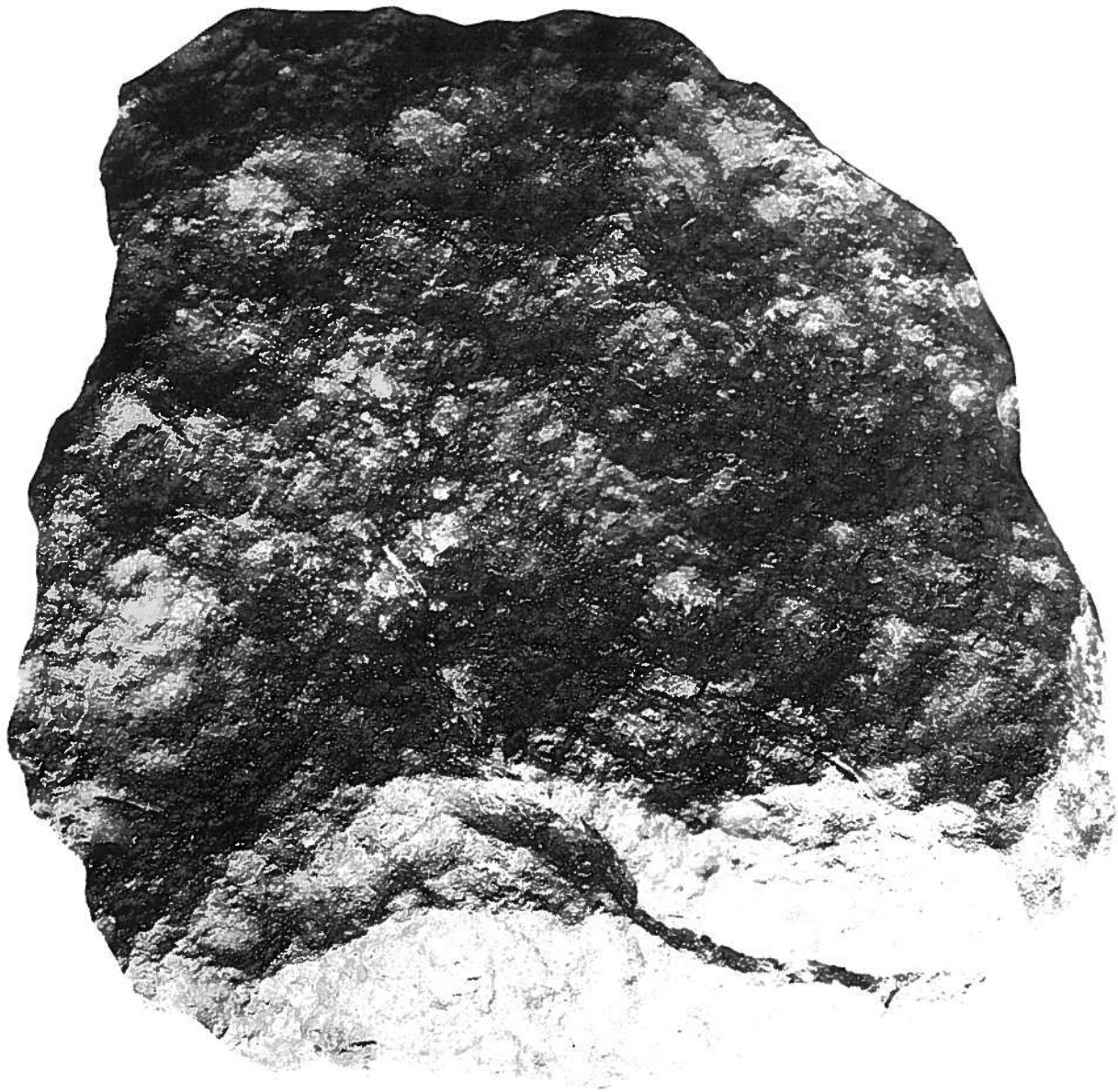
U. S. National Museum	10,500 grams	Washington, D. C.
American Museum of Nat'l History	270 grams	New York, N. Y.
Harvard University	248 grams	Cambridge, Mass.
Chicago Museum of Nat'l History	215 grams	Chicago, Ill.
University of Michigan	102 grams	Ann Arbor, Mich.

References

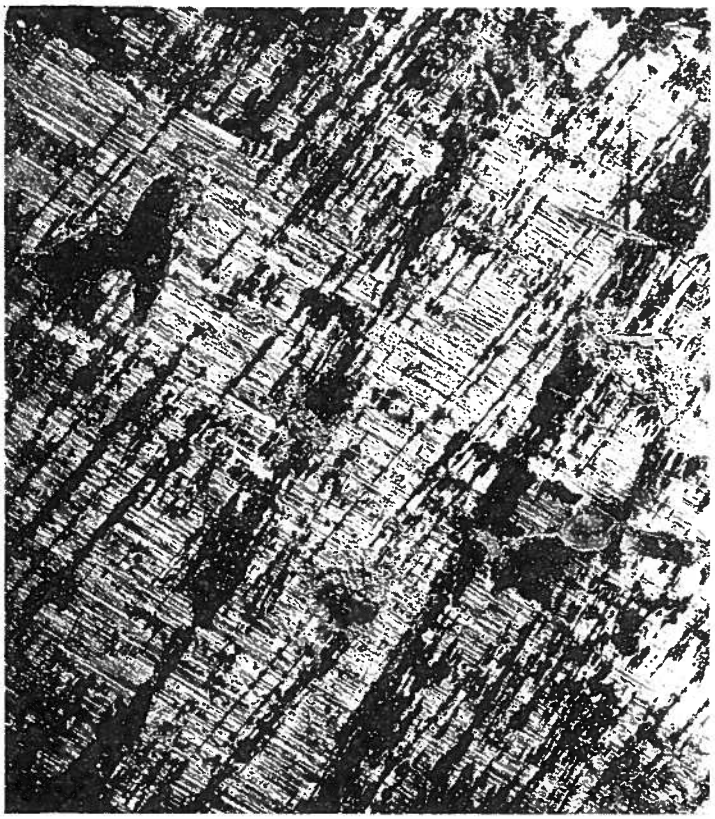
Goldberg, E., Uchiyama, A. and Brown, H., 1951. The distribution of nickel, cobalt, gallium, palladium and gold in iron meteorites., Geochemica et Cosmochemica Acta, 2, 1-25.

Perry, S. H., 1946, The Cedartown, Georgia Meteorite, Smithsonian Misc. Coll., v. 104, 1-3.

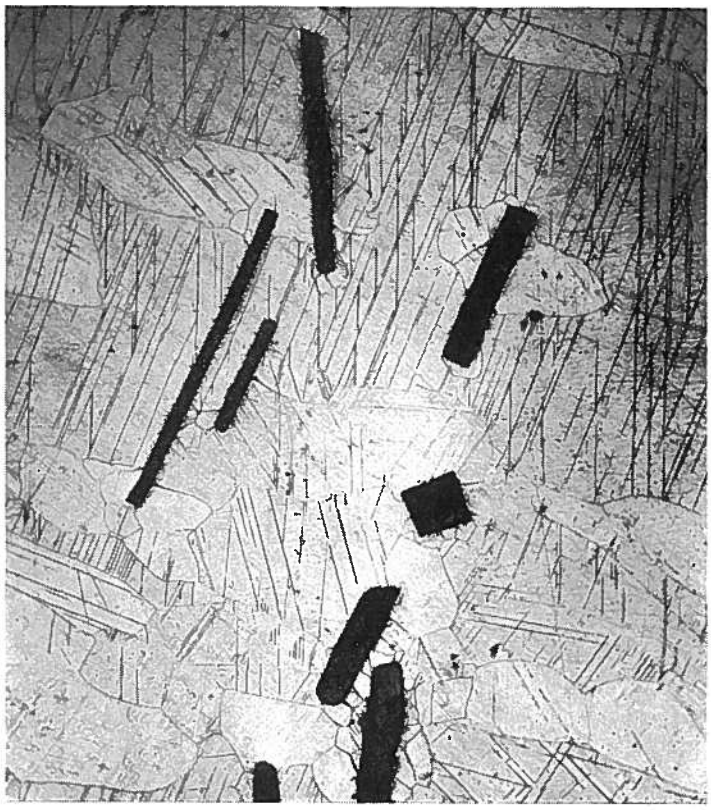
CEDARTOWN



All the features that formed during the flight of the Cedartown iron have been removed by weathering. The open fracture extends part way through the iron, however, the fracture can be traced much farther than the open crack. If the crack were extended it would separate this 3" slab into two similarly shaped masses. About actual size.



A



B

Photomicrographs of the Cedartown iron

A. The Neumann lines run diagonally from the upper left to the lower right. The dark bands, which are essentially parallel to each other and almost at right angles to the Neumann lines, are due to an arrangement of carbon and phosphide particles. Mag. about 10x.

B. The kamacitic groundmass has a granular structure and each grain has one or more sets of Neumann lines. The dark rhabdites which extend across the kamacite grains, lie parallel to one set of Neumann lines. The square outline represents a cross section of a rhabdite inclusions. Mag. 100x.

4. Dalton, Whitfield County

J. L. Smith, 1877, first mentioned the Dalton meteorite and Brezina, 1880, described a sample he had received in Vienna, Austria. Then W. E. Hidden, 1881, described an iron found about 30 miles northeast of Dalton near the Tennessee and North Carolina state lines.

This last named iron was assumed to be terrestrial iron until George B. Little, State Geologist of Georgia, recognized its real nature and procured it for the Museum in Atlanta.

According to Hidden, 1881, this specimen weighed 13 pounds when found. However, on the way to Atlanta something happened to it, because Dr. Little found the meteorite only weighed 9¾ pounds when it arrived.

According to Hidden this rusty meteorite was oblong and had many jagged points on its surface. Furthermore, it showed a tendency for droplets of iron chloride to form on its surface. Thus, this specimen is somewhat unstable as iron chloride attacks meteoritic iron rapidly.

Shepard, 1883, described an iron weighing 117 pounds which was found on the Francis M. Anderson farm in 1879, on lot 109, in the 10th district, and 3rd section of Whitfield County, Georgia. In 1879 this locality was about 14 miles northeast of Dalton. This iron was found while plowing and was buried about 6 inches below the surface of the ground. This specimen which is now in the U. S. National Museum apparently does not exude iron chloride and is stable.

G. F. Kuntz, 1887, in writing about the Cleveland, Tennessee, iron suggested that it might be identical with the Dalton meteorite because Cleveland, Tennessee, is about 28 miles north of Dalton, Georgia. The Cleveland meteorite came from near the Tennessee and Georgia state lines. However, G. P. Merrill, 1916, compared sections of the three samples, (Dalton, described by Shepard, the Dalton described by Hidden and the Cleveland, described by Kuntz), and said, ". . . I am, on the grounds of structure and etching peculiarities, convinced that the irons represent two distinct falls and would suggest that the Hidden iron be known as first described, under the name Whitfield County and that described by Shepard as Dalton. They will be so listed in future in the U. S. National Museum Catalogue."

The catalog of the U. S. National Museum collection published by Merrill in 1916 appeared before this fact was known. It was not discovered until this manuscript was prepared that the records at the U. S. National Museum had never been changed. The larger of the two Dalton samples (Shepard's) is in the collection at the U. S. National Museum.

Merrill, 1916, published an analysis of the Dalton iron by Whitfield and this agrees with the nickel and iron determinations made by Nichols. However, we do not know which of the Dalton specimens were sampled for these analyses.

	Fe	*Ni*	*Co*	*S*	*P*	*Cu*	*Analyst*
1	91.46	7.57	0.55	0.025	0.095	0.016	Whitfield
2	91.02	7.38	.....	.....	.....	.....	Nichols

Specimens of the Dalton iron are in the following collections:

U. S. National Museum	51,831 grams	Washington, D. C.
Harvard University	439 grams	Cambridge, Mass.
Chicago Museum of Natural History	92 grams	Chicago, Illinois
American Museum of Natural History	76 grams	New York, N. Y.
Academy of Natural Sciences	63 grams	Philadelphia, Pa.
Yale University	42 grams	New Haven, Conn.
[1]American Meteorite Museum	35 grams	Sedona, Arizona
Naturhistorischen Hofmuseum	2,924 grams	Vienna, Austria
British Museum (Natural History)	264 grams	London, England
Museum d'Histoire Naturelle	89 grams	Paris, France
Museum des Konigreiches Bohmen	36 grams	Prague, Czech.
University of Bonn	21 grams	Bonn, Germany
University of Strasbourg	16 grams	Strasbourg, France

[1]Amherst College, at one time had a 35 gram sample, possibly this specimen came from Amherst but if that is not the case there is a 35 gram sample at Amherst College.

References

Brezina, A., 1880 Vorlaufiger Bericht uber neue order wenig bekannte Meteoriten. Sitzber, Akad. Math. Naturw. Kl. Wien v. 82, 348-52.

Farrington, O. C., 1915, Meteorites of North America. Mem. Nat. Acad. Sci., v. 13, 155.

Hidden, W. E., 1881, On the Whitfield County, Georgia Meteoric Iron. Amer. Journ. Sci., v. 21, 286-287.

Kuntz, G. F., 1887, East Tennessee (?) Meteorite. Amer. Journ. Sci., v. 34, 473-4.

Merrill, G. P., 1916, (a) Notes on the Whitfield County, Georgia Meteoric Irons. with new analyses. Proc. U. S. Nat. Mus., v. 51, 447-449.

Merrill, G. P., 1916, (b) Handbook and Descriptive Catalogue of the Meteorite Collection in the U. S. National Museum, U. S. Nat. Mus. Bull. 94.

Shepard, C. U., 1883, On Meteoric Iron from near Dalton, Whitfield County, Georgia. Amer. Journ. Sci., (3) v. 26, 336-338.

Smith, J. L., 1877, Two New Meteoric Irons. Amer. Journal. Sci., (3) v. 14, 246.

DALTON

Dalton (Hidden)

Dalton (Shepard)

Although both of these Dalton sections are medium octahedrites there are some conspicuous differences between these irons. The kamacite lamellae in Hidden's sample are wider and the bands are wavy, while the lamellae in Shepard's sample are narrow and have straighter sides. Hidden's sample contains more and larger plessite areas than Shepard's. Also, the plessite is darker and some areas contain delicate kamacite and taenite lamellae. No detectable troilite inclusions were noticed in Hidden's sample but three small masses occur in Shepard's sample. Alteration has penetrated both slices. About natural size.

5. Elberton, Elbert County

The Elberton meteorite was first listed in S. H. Perry's 1947 catalog and then in Hey's 1953 catalog. There is no historical information available about this iron. Apparently, someone sent this piece of meteoritic iron to Perry hoping he would purchase it and Perry recorded it under the name of the post office from which it was sent.

The Elberton and the Smithonia appear to be the same as the town of Elberton is close to where the Smithonia iron was found and was the post office address of Mr. Corbett Simmons, who found the Smithonia meteorite.

In December 1941, Mr. Simmons sent a specimen of the Smithonia iron to the U. S. National Museum for examination but he sold the iron to the Chicago Museum of Natural History about a year later. When S. K. Roy and R. K. Wyant, 1950, described this meteorite they said, ". . . The Smithonia meteorite was secured by purchase from Mr. Corbett Simmons, of Elberton, Georgia. Negotiations for the purchase began in November 1941 but no settlement was arrived at until September 1952. During the interval Mr. Simmons apparently corresponded with others interested in the meteorite."

The evidence that the Elberton iron is a fragment of the Smithonia meteorite is convincing enough to justify dropping the Elberton name from meteoritic lists.

References

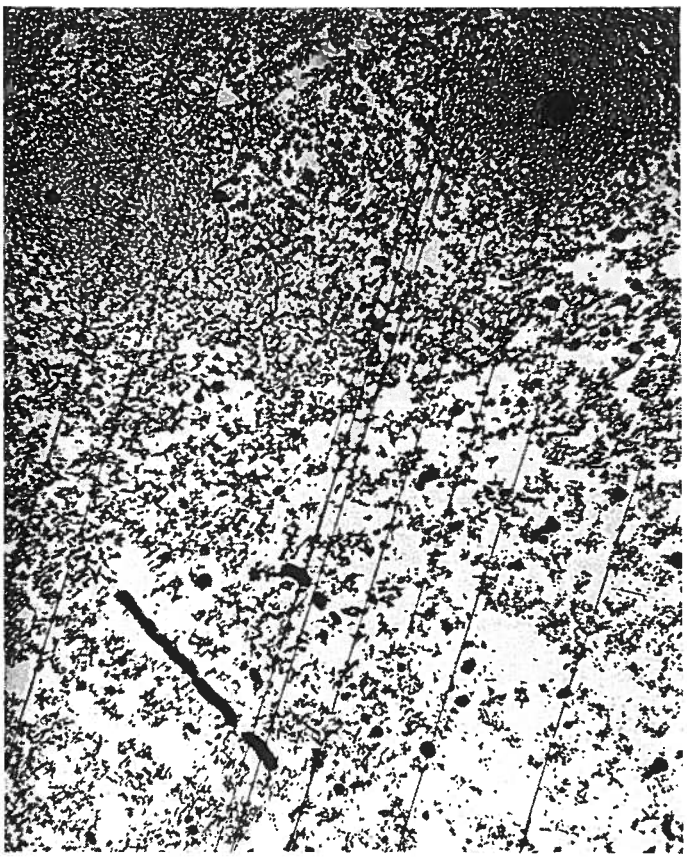
Hey, Max H., 1953. Catalogue of Meteorites.

Perry, Stuart H., 1947, Meteorite Collection of Stuart H. Perry.

6. Forsyth, Monroe County

This stone, a veined chondrite, fell on May 8, 1829, at 3:30 p.m. E.S.T., and was the first witnessed meteorite to fall in Georgia.

Silliman, 1830, reported, ". . . . a small black cloud appeared south of Forsyth from which two distinct explosions were heard, following in immediate succession, succeeded by a tremendous rumbling or whizzing noise passing through the air, which lasted from the first account for two to five minutes. This extraordinary noise was on the same evening accounted for by Mr. Sparks and Captain Postain, who happened to be



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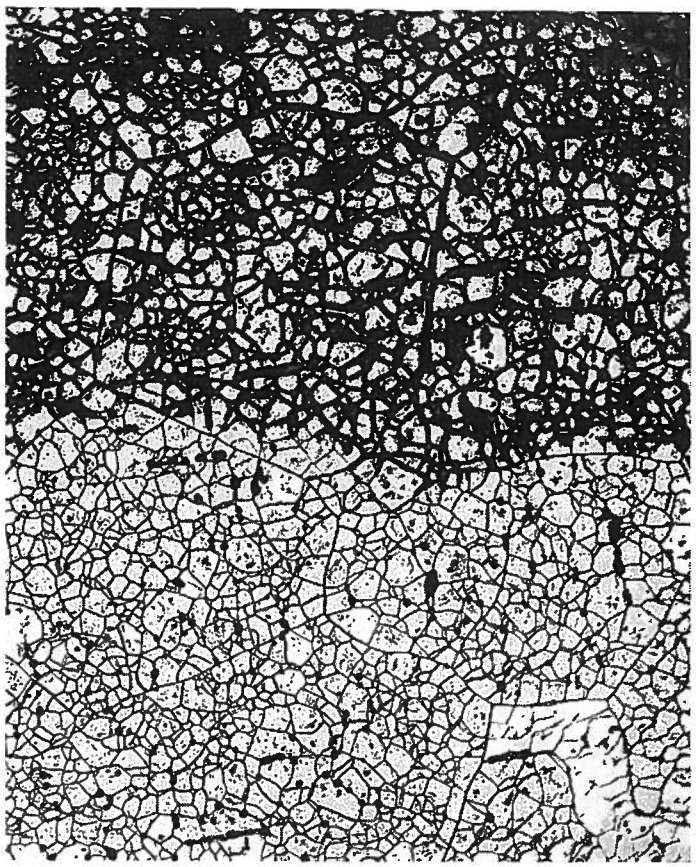


B

A. Because of the fine parallel markings, Neumann lines, and the chemical composition the Holland's Store meteorite is classified as hexahedrite. The black rod-like inclusion, at the lower left, may be rhabdite. 100x.

B. Another area in Holland's Store shows the invasion of alteration products and the granular structure. On the basis of this picture this iron could be incorrectly classified as a nickel-poor-ataxite because of the lack of Neumann lines. 50x.

near some Negroes working in a field, one mile south of this place, who discovered a large stone descending through the air, weighing, as was afterwards ascertained, 36 pounds. The stone was, in the course of the evening or very early next morning recovered from the spot where it fell. It penetrated the earth 2.5 feet."

Although 36 pounds of this meteorite were recovered, most of it was lost. There is no reliable scientific data on this meteorite today and its partial analysis is of no value. The only sample of this stone that was available to the authors weighed only 9 grams.

Specimens of the Forsyth meteorite are in the following collections:

Yale University	132 grams	New Haven, Conn.
American Museum of Nat'l History	95 grams	New York, N. W.
Chicago Museum of Nat'l History	87 grams	Chicago, Ill.
U. S. National Museum	9 grams	Washington, D. C.
Harvard University	70 grams	Cambridge, Mass.
Naturhistorischen Hofmuseum	88 grams	Vienna, Austria
British Museum (Natural History)	72 grams	London, England
Hungarian National Museum	21 grams	Budapest, Hungary
Friedrick-Wilhelms University	19 grams	Berlin, Germany

References

Silliman, B., 1830. Georgia Meteor and Aerolite. Amer. Journ. Sci. (1) vol. 18, pp. 388-399.

White, George, 1849. Statistics of the State of Georgia, Savannah. W. Thornes Williams, pp. 428-429.

7. Holland's Store, Chattooga County

This 27 pound iron which belongs to the hexahedrite group was found in March of 1887. According to Kuntz 1887, it fell into the hands of some people who were interested in developing iron mines and was broken up. Pieces were given to a blacksmith to be made into horseshoes, nails, et cetera. Kuntz further says, ". . . . the cleavage is in some parts very marked and the two cleavage angles measured were 120°. In breaking up the iron four cleavage pieces were obtained, one of the surfaces being two centimeters square and the other three centimeters square each, which was very smooth and bright."

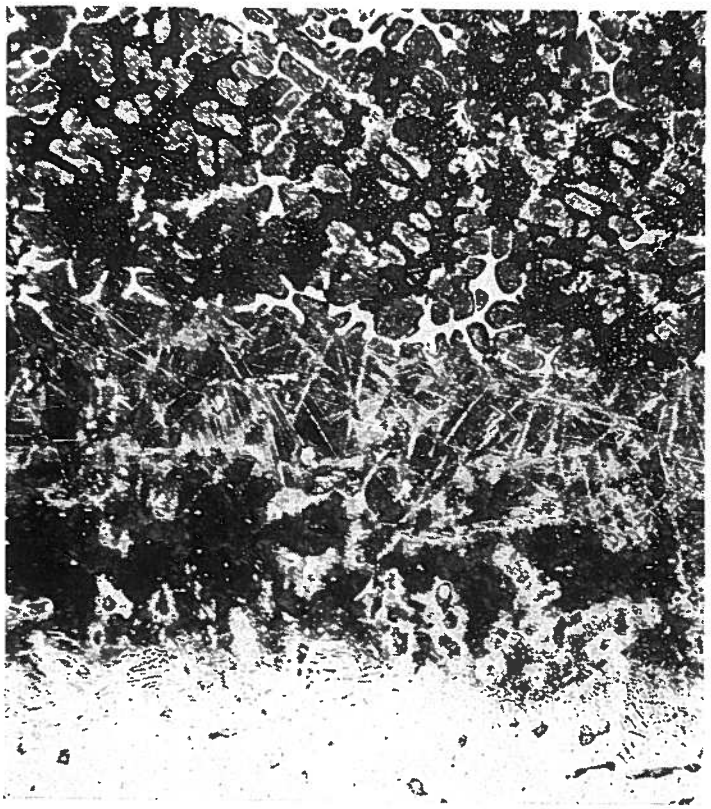
The structure of this iron is shown in the attached illustration. The Neumann lines can be seen extending almost to the edge of the specimen where they disappear. Since this structure was observed on a 117 gram sample, it is impossible to tell just where the pieces came from the main mass. The zone in which Neumann lines are missing may be near the surface where the metal could have been thermally heated in flight. Such zones are rather common in hexahedrites.

Cohen, 1906, published the following analysis of this iron:

Fe	*Ni*	*Co*	*Cr*	*S*	*P*	*Analyst*
93.06	5.35	1.00	0.23	0.08	0.31	Zaubitzer

Specimens of the Holland's Store meteorite are in the following collections:

American Museum of Natural History	228 grams	New York, New York
Chicago Museum of Natural History	376 grams	Chicago, Illinois
University of Michigan	117 grams	Ann Arbor, Michigan
U. S. National Museum	17 grams	Washington, D. C.
Naturhistorischen Hofmuseum	888 grams	Vienna, Austria
Yale University	126 grams	New Haven, Conn.
Hungarian National Museum	64 grams	Budapest, Hungary



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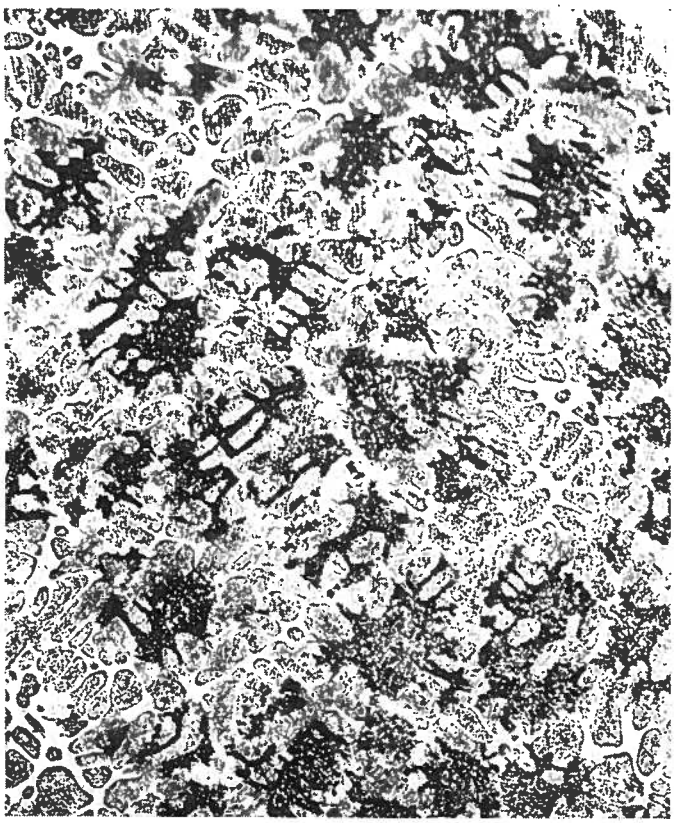


B

A. The interface of a large dendritic inclusion (above) and a zone of acicular structures (middle area). The former apparently consists of dendrites of an Fe-Fe_3C aggregate (gray), surrounded by Fe-P-C eutectic (clear white) known in artificial irons as steadite, (Fe, Fe_3P, Fe_3C), all in a mottled nearly black matrix having the appearance of an iron-graphite eutectic in artificial irons. The acicular portion is a form of Fe-Fe_3C Widmanstatten structure. With light etching no structure is shown in the adjacent kamacite below. Picral 30 sec. 40x.

B. Part of the dendritic area shown in A. It resembles a structure in a high phosphorous cast iron. The rounded or elongated gray bodies are the Fe-Fe_3C aggregate referred to above. The perfectly clear matrix surrounding them is steadite. The dark mottled areas are apparently iron-graphite eutectic. Picral 30 sec. 45x.

Museum des Konigreiches Bohemen	47 grams	Prague, Czechoslovakia
Freiderich-Wilhelm University	51 grams	Berlin, Germany
University of Bonn	40 grams	Bonn, Germany
Museum d'Histoire Naturelle	30 grams	Paris, France
University of Roma	27 grams	Rome, Italy
Academy of Sciences	12 grams	Moscow, U. S. S. R.

References

Cohen, E., 1905. Classification und Nomenclatur; Kornige bis dichte Eisen: Hexaedrite; Oktaedrite mit feinsten und feine Lamellen. Meteoriten-kunde, Heft 3.

Kuntz, G. F., 1887. On some American meteorites, The Chattooga County, Georgia, Meteorite. Amer. Journ. Sci. (3), vol. 34, pp. 471-472.

8. Locust Grove, Henry County

This 22 pound iron was found July 29, 1857, in Henry County, near Locust Grove but remained in private collections until 1895. Cohen, 1897, described it but reported it as a North Carolina meteorite, however, he corrected the mistake in 1905.

Cohen, 1897, reports the meteorite as shaped like a jawbone. Its surface shows a thin coating of rust and patches of fusion crust. He classified it as a nickel-poor-ataxite, described some of the unusual structures, and published the following analysis which is consistent for meteorites of this group.

Fe	*Ni*	*Co*	*C*	*P*	*Cl*	*Analyst*
94.30	5.57	0.64	0.02	0.18	0.01	Sjostrom

Perry, 1944, critically examined this iron, classified it as a nickel-poor-ataxite and discussed its iron-carbon structures. The photomicrographs of this iron are reproduced and Perry's comments about the structures are given in the accompanying explanations.

Perry found only two examples of unquestionable iron-carbon structures in meteorites and both were nickle-poor-ataxites. The origin of this structure is not fully understood but probably it represents strong reheating of an iron having Ni-Fe ratios near those of the hexahedrites and one which contained inclusions of cohenite. The reheating was followed presumably by relatively rapid cooling.

The above described condition possibly could exist near the surface of a hexahedrite as it falls through our atmosphere because there is a narrow zone that is heated and cooled quickly. The changes introduced, as an iron meteorite passes close to the sun, probably would produce different structures in an iron. Such a meteorite, one would think, would get a uniform structure if it were a comparatively small body. As it approached perihelion it would receive increasing amounts of heat, then as it receded it would slowly cool.

The structure in the other samples of the Locust Grove meteorite need to be examined critically to see if they are similar to those Perry found as his study was made on a small sample which someone could have heat-treated.

C

D

C. The area shown in B, but with an additional etching of 3 minutes with neutral sodium picrate. The clear areas shown in B are now black, indicating that they are an Fe-Fe_3C aggregate. The unchanged dark mottled areas (black with white flecks), indicate they are a phosphorus free aggregate of nickel-iron and graphite. 45x.

D. A portion of the area shown in B and C, unetched. The component that is visible unetched is that of the mottled black areas in figure B, showing a gray color suggesting the appearance of graphite in artificial iron. The large clear area corresponds with the other components in B, the gray dendrites are the clear phosphide eutectic surrounding them; being wholly metallic these show no structure without etching.

Specimens of the Locust Grove meteorite are in the following collections:

Yale University	2,011 grams	New Haven, Conn.
American Museum of Nat'l History	697 grams	New York, N. Y.
Chicago Museum of Nat'l History	597 grams	Chicago, Ill.
American Meteorite Museum	212 grams	Sedona, Ariz.
U. S. National Museum	163 grams	Washington, D. C.
University of Michigan	142 grams	Ann Arbor, Mich
Harvard University	93 grams	Cambridge, Mass.
Amherst College	47 grams	Amherst, Mass.
University of Bonn	958 grams	Bonn, Germany
British Museum (Natural History)	571 grams	London, England
Freiderick-Wilhelm University	65 grams	Berlin, Germany
Naturhistorischen Hofmuseum	54 grams	Vienna, Austria

References

Cohen, E., 1897. Uber ein neuer meteoreisen von Locust Grove, Henry County, Nord-Carolina. Sitzber, Berlin Akad., pp. 76-81.
Cohen, E., 1905. Meteoritenkunde, Heft 3, pp. 44-77.
Perry, S. H., 1944. Metallography of Meteoric Iron. U.S. Nat. Mus. Bull. 184.

9. Losttown, Cherokee County

This iron, a medium octahedrite, was found, according to Shepard, 1869, on Michael Sullivan's farm located about 2.5 miles southwest of Losttown, April 1868. The locality given does not appear on maps or postal guides but there is a creek by that name in Cherokee County. The meteorite, when found, weighed 6 pounds 10 ounces and resembled a human foot.

Brezina, 1895, said that the kamacite plates varied from 0.4 to 0.6 millimeters, the lamellae partly grouped, partly isolated, always puffy. He further stated that schreibersite was abundant and irregularly distributed.

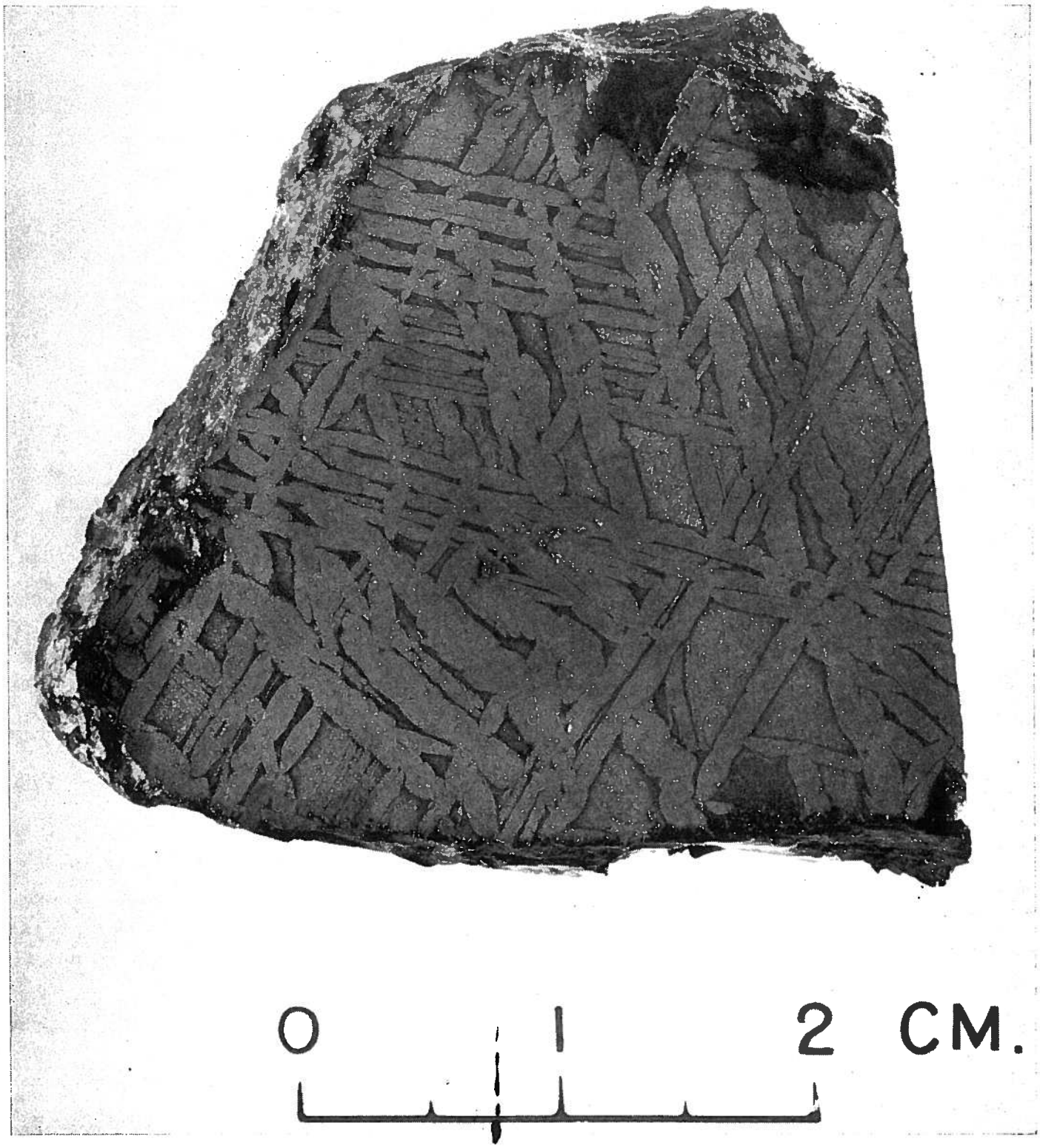
It is difficult to reconcile Brezina's description of this meteorite and the accompanying picture of the specimen in the U. S. National Museum. The kamacite lamellae in the specimen shown are wavy but these bands are almost twice as wide as Brezina reports. Also schreibersite is far from being abundant, however, this specimen is small and may not represent the average structure for this iron.

Specimens of the Losttown meteorite are in the following collections:

Amherst College	3,050 grams	Amherst, Mass.
American Museum of Nat'l History	926 grams	New York, N. Y.
U. S. National Museum	99 grams	Washington, D. C.
American Meteorite Museum	89 grams	Sedona, Ariz.
Harvard University	13 grams	Cambridge, Mass.
Yale University	3 grams	New Haven, Conn.
Naturhistorischen Hofmuseum	34 grams	Vienna, Austria
British Museum (Natural History)	7 grams	London, England
Hungarian National Museum	22 grams	Budapest, Hungary
Vatican	3 grams	Vatican City, Italy
University of Strasbourg	2 grams	Strasbourg, France

References

Brezina, A., 1895. Die Meteoritensammlung des k. k. naturhistorischen Hofmuseums am 1 Mai, 1895, pp. 279.
Shepard, C. U., 1868. A new locality of meteoric iron in Georgia. Amer. Journ. Sci., vol. 46, pp. 257-258.



The Losttown meteorite, a medium octahedrite, contains numerous plessite areas. The kamacite lamellae are wavy and enclosed with well defined taenite bands. The average thickness of 10 kamacite bands is 1.1 millimeters. Mag. 4.5x.

10. Lumpkin, Stewart County

This stony meteorite, a hypersthene chondrite, weighed 12¼ ounces. It fell October 6, 1869 on land owned by Captain Elbridge Barlow which then was located about twelve miles southwest of Lumpkin. It was picked up a few moments after it struck. Willet, 1870, quotes Captain Barlow as saying, ". . . . while standing in the open yard, the sky being bright and clear, he heard first a succession of about three explosions, followed by a deep roaring for several seconds, and then by a rushing or whizzing sound of something rushing with great speed through the air nearby. The sound ceased suddenly. The noise continued from first to last about half a minute. Two Negroes were working near by the well in the same yard, about sixty yards from where Mr. Barlow stood. They heard the noise and supposed it to be the falling in of the plank well curbing, banging from side to side in its descent, and so spoke of it to one another before the meteorite fell. While they were speaking thus about the noise, the meteorite fell and struck the ground about 20 steps from them, in full sight knocking up the dirt. They called Captain Barlow and showed him the spot. It was upon very hard trodden ground in the clean open yard. The earth was freshly loosened up very fine in a circle of about 18 inches in diameter, and upon scraping the loose dirt away with the hands the stone was found about 10 inches below the surface. From the direction in which the ground was crushed in it must have come from the northwest and at an angle of about 30°. The stone when picked up was covered with black shell . . . The stone still has a strong odor. He does not remember that it had any noticeable heat." Willet's account mentions that the sound of this fall was heard over considerable area and cites an instance of noise being heard 18 miles away.

J. L. Smith, 1870, said that this meteorite contained about 7 percent Ni-Fe and the metal contained about 12 percent nickel. Also, that troilite made up about 6.10 percent of the meteorite and that silicates, (pyroxene, olivine and feldspars) about 86.9 percent. The descriptions of this stone are not sufficiently complete to identify it. Since the samples in the collections are small, it is unlikely that a comprehensive study of this meteorite will be made.

According to Willet, 1870, a specimen of the Lumpkin stone was given to Mercer University, Macon, Georgia, but we have been unable to verify if this sample is preserved.

Specimens of the Lumpkin stone are in the following collections:

Mineralogical Museum, Harvard	53 grams	Cambridge, Mass.
U. S. National Museum	29 grams	Washington, D. C.
American Museum of Natural History	24 grams	New York, N. Y.
Chicago Museum of Natural History	3 grams	Chicago, Ill.
Naturhistorischen Hofmuseum	25 grams	Vienna, Austria
British Museum (Natural History)	17 grams	London, England
Hungarian National Museum	5 grams	Budapest, Hungary
University of Bonn	1 gram	Bonn, Germany

References

Smith, J. L., 1870. Fall of a meteorite in Stewart County, Georgia. Amer. Journ. Sci. (2), vol. 50, pp. 339-341, p. 293.

Willet, J. E., 1870. Account of the fall of a meteoric stone in Stewart County, Georgia. Amer. Journ. Sci. (2), vol. 50, pp. 335-338.

11. Paulding County

This meteorite, a coarse octahedrite, was described by Thomas Leonard Watson, 1913, and is said to have been found in the extreme northern corner of Paulding County, Georgia. When found it was a deeply weathered, rough, irregular object, with considerable limonite on its surface. Its weight was given as 725 grams in 1912 but, today, only about 400 grams of it are known.

The chemical analysis, Watson published, is compared with the analysis of the Canton, Georgia, meteorite.

	Fe	*Ni*	*Co*	*P*	*S*	*Analyst*
Paulding	93.26	6.34	0.50	0.23	none	Thornton
Canton	91.96	6.70	0.50	0.11	0.01	Stokes

Watson, assisted by Merrill, compared the Paulding iron with the Canton, Georgia, meteorite and two irons from Tennessee, the Cleveland and Cooperstown. Their conclusion was, ". . . In neither case, was the resemblance close, but only very general and so far as the comparison has value it must be concluded that the Paulding County iron is different from any yet found in Georgia and adjoining states in the collection of the U. S. National Museum."

Watson, 1913, said he had obtained the meteorite 12 years before. This statement indicates that the specimen was either in the University of Virginia collections, or it was in Watson's personal collection. Recent communications with Professor W. A. Nelson, of the University of Virginia, indicate that the Paulding sample is not on deposit in their collections.

Specimens of the Paulding County meteorite are in the following collections:

American Museum of Natural History, 100 grams, New York, New York;

Chicago Museum of Natural History, 312 grams, Chicago, Illinois.

REFERENCES

Watson, T. L., 1913. A Meteoric iron from Paulding County, Georgia. Amer. Journ. Sci., vol. 36, pp. 165-168.

12. Pickens County

This 400 gram stone, chondrite, was found about 1908 in Pickens County according to McCallie, 1919, who says, ". . . when this was found it was roughly cubical with the appearance of being part of a larger piece. In color and texture it closely resembles basalt, the dark color being blotched here and there by brownish-red spots which seem to be due to oxidization of the contained particles of metallic iron. With the exception of the metallic iron, which occurs in irregular masses a fourth of an inch or less in diameter and which makes up something like 10 percent of the entire mass none of the other minerals can be made out without a lens."

Recently, Furcron found a reference in a letter he received from R. L. Hunter of Fairmount, Georgia, February 16, 1949, which stated, ". . . On March 4, 1911, Clark Thomson gave Mr. A. B. Park a small piece of a stone which was turned over to me and which the State Geologist, McCallie, identified as a meteorite. This stone was picked up on Land Lot No. 88, 23rd District, 2nd Section of Pickens County, at a little store named Talmadge. It is about 6 miles east of Fairmount, Georgia."

Analysis of the Pickens County, Georgia, Stone.

SiO_2	37.06	TiO_2	0.09
Al_2O_3	5.83	P	0.31
Fe_2O_3	10.69	S	1.57
FeO	9.63	Cr_2O_3	0.40
MgO	24.00	MnO	0.40
CaO	0.55	Fe	8.22
Na_2O	0.92	Ni	1.23
K_2O	0.02	Co	0.11
H_2O			

McCallie published the above analysis made by Edgar Everhart and wrote that the Pickens County stone is similar to Long Island, Kansas; Bluff, Texas; Shelburne, Ontario, and Bjurbole, Finland.

The four analyses which McCallie listed agree with Pickens

County in the SiO_2 and MgO percentages, however, there are differences to which McCallie apparently attached no significance. The authors, who probably have more analyses of meteorites available for comparison than McCallie had, found 39 analyses of stony meteorites, exclusive of those McCallie mentioned, which averaged for SiO_2 and MgO, 37.66 and 24.08 percent respectively.

The above similarity of meteorites may be of some interest, since the meteorites selected were chosen because of similarity of the determinations on two elements and without regard to the geographic distribution or the mineralogical or physical similarities of the meteorites. Thus, it may be that SiO_2 and MgO contents of one type of stony meteorites averages about 37.5 percent and 24 percent respectively. Certainly all of these analyses are not equally good, however several of the recent analyses included were made by some of the best analysts. The average of 39 determinations should give a figure that is approximately correct for both SiO_2 and MgO.

The only known specimen of this stone is in the Chicago Museum of Natural History, Chicago, Illinois, and weighs 380 grams.

REFERENCES

Furcron, A. S. Personal communications.
McCallie, S. W., 1909. The Pickens County Meteorite. Science V., vol. 30, pp. 772-773.

13. Pitts, Wilcox County

The Pitts meteorite which fell on April 20, 1921 about 9:00 A.M., is usually listed as an iron with silicate inclusions. However, because of the nature of the metallic portions and the abundance of silicates in the specimen in the U. S. National Museum, it seems appropriate to classify this as a mesosiderite. But in so doing, mesosiderite implies a meteorite intermediate between the irons and the stones and is not descriptive of the silicate inclusions in this specimen.

McCallie, 1922, described the fall by saying, ". . . at the time of the fall no clouds were in view and the sun was shining brightly. It was seen as far north as Sunny Side, in Henry County, 36 miles south of Atlanta, and as far south as Moultrie in Colquitt County. In addition to the above towns that appear to mark the north and south limits of its visibility, it was also seen at Camilla, Albany, Seville, Cordele, Hawkinsville, Perry, Macon and Alma. It was, no doubt, plainly visible over an area of several thousand square miles and could have been distinctly seen by fully a quarter of a million people had they been looking in the proper direction."

McCallie, in the Cordele Dispatch and Daily Sentinel, May 10, 1921 reported, ". . . Dense smoke in the wake of the flaming fire ball was referred to by the Albany and Moultrie witnesses as a luminuous trail following the flaming ball. Colonel Dorris who was in the vicinity of Pitts speaks of the smoke as a zigzag trail lingering for several minutes and assuming various shapes."

"The first sound heard was compared to that of thunder and to many it was the first warning that an unusual occurrence was taking place in the sky above. At Cordele, 15 miles west of Pitts the sounds resembled that of a heavy explosion distinctly heard by several people in the street. In the country 4 miles east of Cordele, two terrific explosions were noted, louder than thunder which so terrified the farm hands that they ran frightened to their homes."

"At Hawkinsville, it was thought that an airplane had exploded over the city. In the immediate vicinity of Pitts, the sounds were described as several loud explosions causing the earth to tremble, followed in quick succession by a number of lesser explosions".

In the magazine section of the Atlanta Constitution of May 1921, there appeared a feature article by McCallie about this meteorite. Also a picture of all four specimens of the Pitts meteorite. That picture is the only one we found showing all the Pitts specimens but unfortunately the details of that picture are not good.

Surely there must be prints someplace and possibly the negative is still available. Unfortunately, the surface features of the other specimens seem to have been overlooked because there is no mention of any particular features they display.

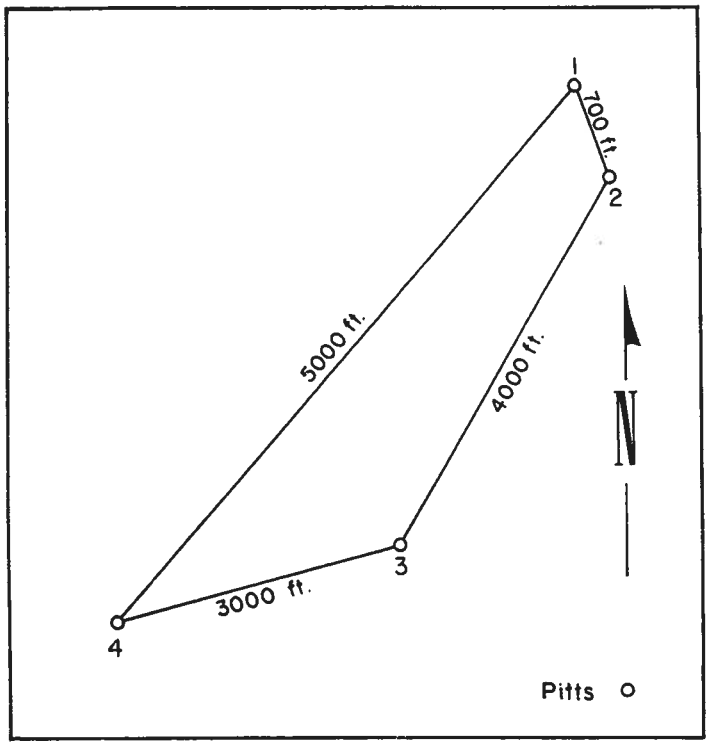
On April 23, 1939, the same paper carried a note, "Georgia Star Sold". This release was made when the Pitts iron was sold to S. H. Perry of Adrian, Michigan, because some local people felt that with this sale the Pitts meteorite might become buried in a private collection. This sale proved a fortunate thing because Perry saw the importance of this specimen and presented it to the U. S. National Museum for preservation.

The Pitts meteorite apparently broke in the air because four individual pieces were found. One piece hit the earth about 75 feet from Nancy Brinson's house and was recovered within a few minutes. Although it penetrated the ground about 16 inches it was not hot when found. Piece number two fell about 700 feet southwest of the Brinson house. This one, containing stony inclusions, weighed 42 ounces and penetrated the ground about 8 inches. This piece nearly made history because it fell so near a boy that it splattered him with flying dirt.

Piece number three fell 4,000 feet southwest of the second specimen and within 100 feet of where a man and a boy were working in King's field. This one buried itself in the ground about seven inches and was said to be warm when recovered.

Piece number four fell unobserved on a public road 5,000 feet southwest of sample number one and weighed less than two ounces. Since four pieces were found, probably, others fell, this area may be worthy of additional prospecting.

The distribution of the four masses, as given by McCallie, are shown in the accompanying line drawing.



Location of Pitts falls according to McCallie, 1—Nancy Brinson's House; 2—Jim Harden's House; 3—King's field; 4—Fourth specimen.

The prominent projections on the meteorite, shown in the following pictures, are essentially made of metal. Thus, its shape must have been determined by the distribution of the metallic inclusions in the original mass. The silicate-troilite inclusions which occur in the low places indicate that type of material was lost faster during the flight than the metallic material.

If the main mass entering our atmosphere was very irregular or if sizeable pieces were attached to the main mass by a connecting bridge of silicate-troilite material, we suspect this last named material could easily fail. Therefore, if the mass entering our atmosphere was very irregular, numerous pieces surely were broken off during its flight and each time a large chunk was lost, the main mass would re-adjust its position in the air. When the reorientation took place possibly the trajectory was changed and this to an observer could make the meteorite appear to be falling in a zig-zag manner.

Near the edge of this meteorite a small hole occurs in a crater-like depression and the metallic rim surrounding the hole curls into the opening. The markings in this rim are shown in some of the accompanying pictures.

The parallel striations above the hole are normal to the edge of the meteorite. These possibly were made when the layer of deformed metal was pushed into the hole or immediately afterwards. The metal to the left of the hole as well as below and slightly to the right, also contains parallel markings which lie at an angle to the striations above the hole. The striations at the top definitely originated in flight and possibly the markings at the left and below the hole. However, these last named structures may be scratches that were made when this meteorite struck the ground.

We believe the hole formed during the flight because of the following reasons: (1) It is located near the rim where the mass is thin, (2) the cut at the right in one of the pictures exposed a silicate-troilite inclusion which extends almost through the metal.

At the top of one of the accompanying pictures there are two masses of metal, separated by a trough like depression. A layer at the lower edge of this trough and just above a sizeable metallic mass, looks as if it flowed over the metal immediately beneath it. Actually, this thin layer is the remnant of a troilite-silicate inclusion.

A portion from this thin layer was crushed and found to contain no magnetic particles. The grains easily dissolved in dilute hydrochloric acid and gave off hydrogen sulfide gas but some dark flocculent residue remained, thus, we assumed that this material is troilite. Tests showed the acid soluble portion contained no nickel and the flocculent particles, which were later dissolved, also contained no nickel.

At the top of one of the pictures there are two large metallic masses which have rounded ridges down the front side. These ridges coincide with the limits of the semi-circular feature in the metallic mass in the central area of this face. The rounded edges in these two metallic bodies surely were made in flight and since the ridges, the trough-like depression and the semi-circular features appear to be related, we assume all these features were made during the fall.

The edges of the two metallic bodies shown at the top of this illustration curl over onto the silicate-troilite areas which undercut the metallic masses. Most of the silicate-troilite areas are covered with a dark colored fusion product.

The surface of this meteorite is obviously complex. Perry, 1944, observed that the fragments of the Pitts fall had furrowed and sculptured surfaces. He also noticed the freshly fractured surfaces and assumed that a sizeable mass, after partly completing its flight in the air, broke apart.

The only specimen that the authors have examined is shown in the accompanying illustration. We believe this specimen tumbled during its fall, because it has no preferred orientation. One side of this meteorite, see pictures, resembles a metallic meteorite but the opposite side creates a different impression. The color of the Ni-Fe alloy is visible on most of the metallic ridges but most of the metallic part is covered with a film of oxide. The material at the bottom of many of the depressions is silicate-troilite.

All descriptions of this meteorite were made years after it was found, so, possibly, the lack of fusion crust on the metallic ridges is due to the handling this sample has received. Each time it was picked up some ridge contacted the hand. Also, these ridges form the points, on which the sample will rest when that side becomes the base. It is doubtful if the Pitts meteorite was handled enough since it has been in the U. S. National Museum's Collection to wear the oxide film away and certainly it was not excessively handled while in Perry's collection. However, it has been handled many times since it fell in 1921.

The face directly opposite the one illustrated, is rough and has more troilite-silicate areas than the side shown. Numerous rounded projections of Ni-Fe alloy extend above the level of that surface and we assume these were shaped during the flight. The troilite and silicate areas usually are covered with a dark fused crust.

The density of the Pitts sample, pictured in this study, is 6.27 which means that considerable quantities of silicates and troilite are present because the density of an iron meteorite is nearly 8 and stony meteorites, essentially free from metallic inclusions, have densities of about 3.5.

McCallie's analyses are not given because these appear to have been made upon poorly prepared samples, however, McCallie quotes Merrill as having examined the silicates and reported olivine, diopside and plagioclase as being present. A re-examination of the silicates confirms the presence of olivine, plagioclase but the mineral assumed to be diopside proved to be one of the hypersthene series. The only analysis of this iron known to the writers is a recent one for nickel and cobalt, made by Raymond W. Stonner, Brookhaven National Laboratory. He reports the nickel values to be 11.39 and 11.45 per cent, and for cobalt he obtained 0.63 and 0.65 percent. It is possible that these analyses would be helpful if someone finds another specimen which might belong to this fall.

The Pitts meteorite illustrates a serious defect in the way scientific specimens are cared for. The documentation of this fall is better than most of the witnessed meteorite falls and for a while the Pitts meteorite received considerable local attention but today only three specimens could be located in collections. The writers would appreciate being advised about any of the other specimens of this fall.

Specimens of the Pitts meteorite are in the following collections:

U. S. National Museum, 1,198 grams, Washington, D. C.

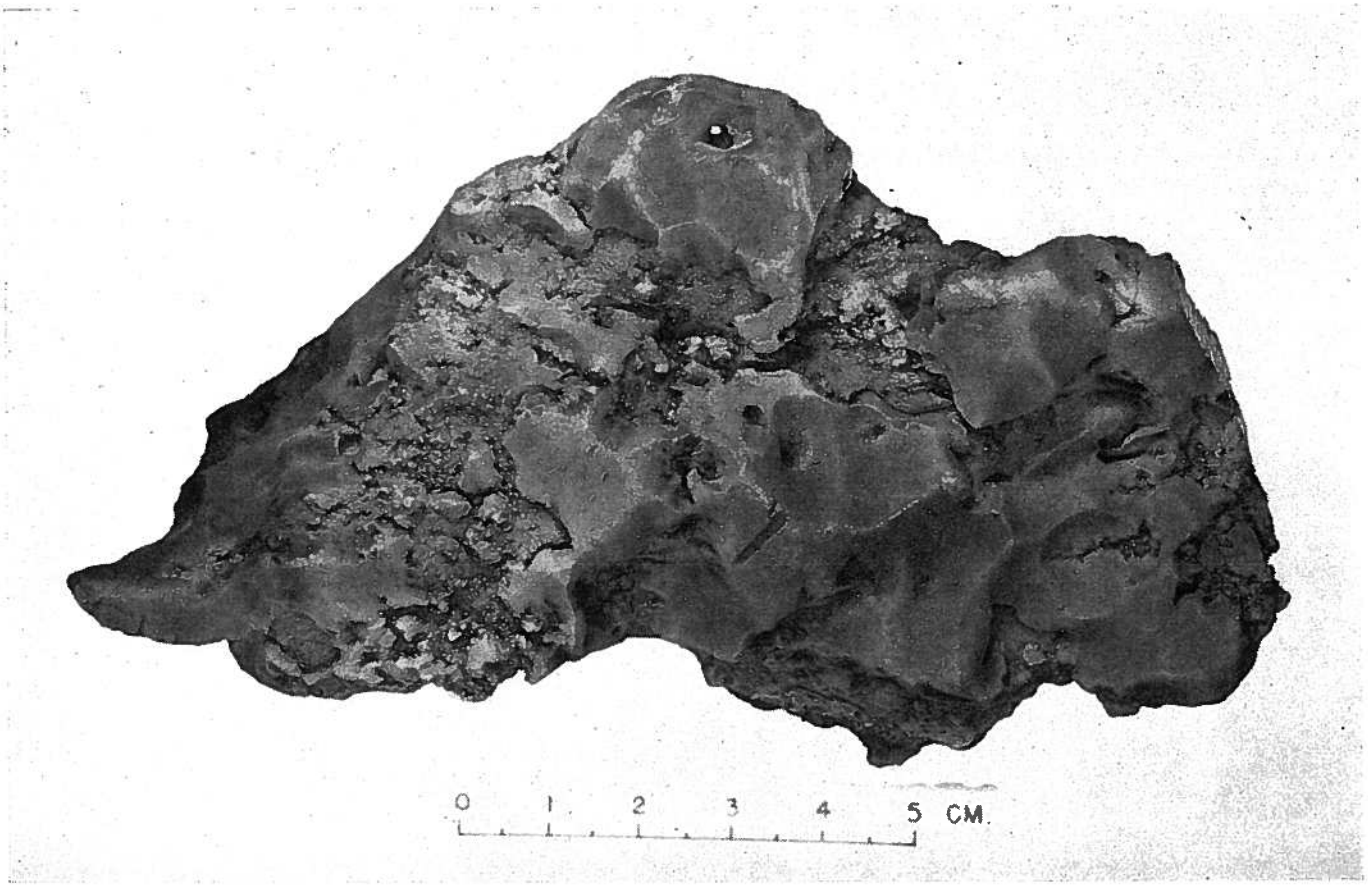
American Museum of Natural History, 46 grams, New York, New York.

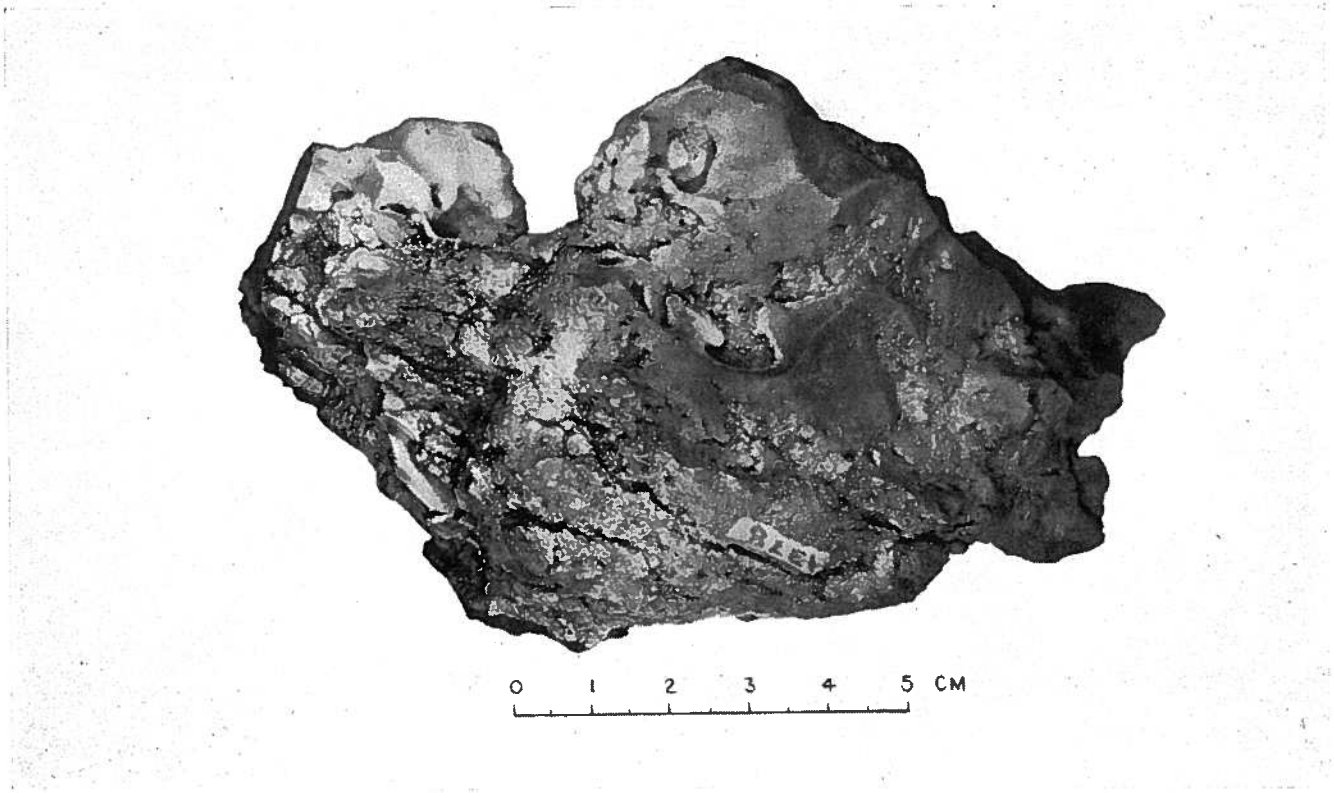
Academy of Sciences, 4 grams, Moscow, U. S. S. R.

REFERENCES

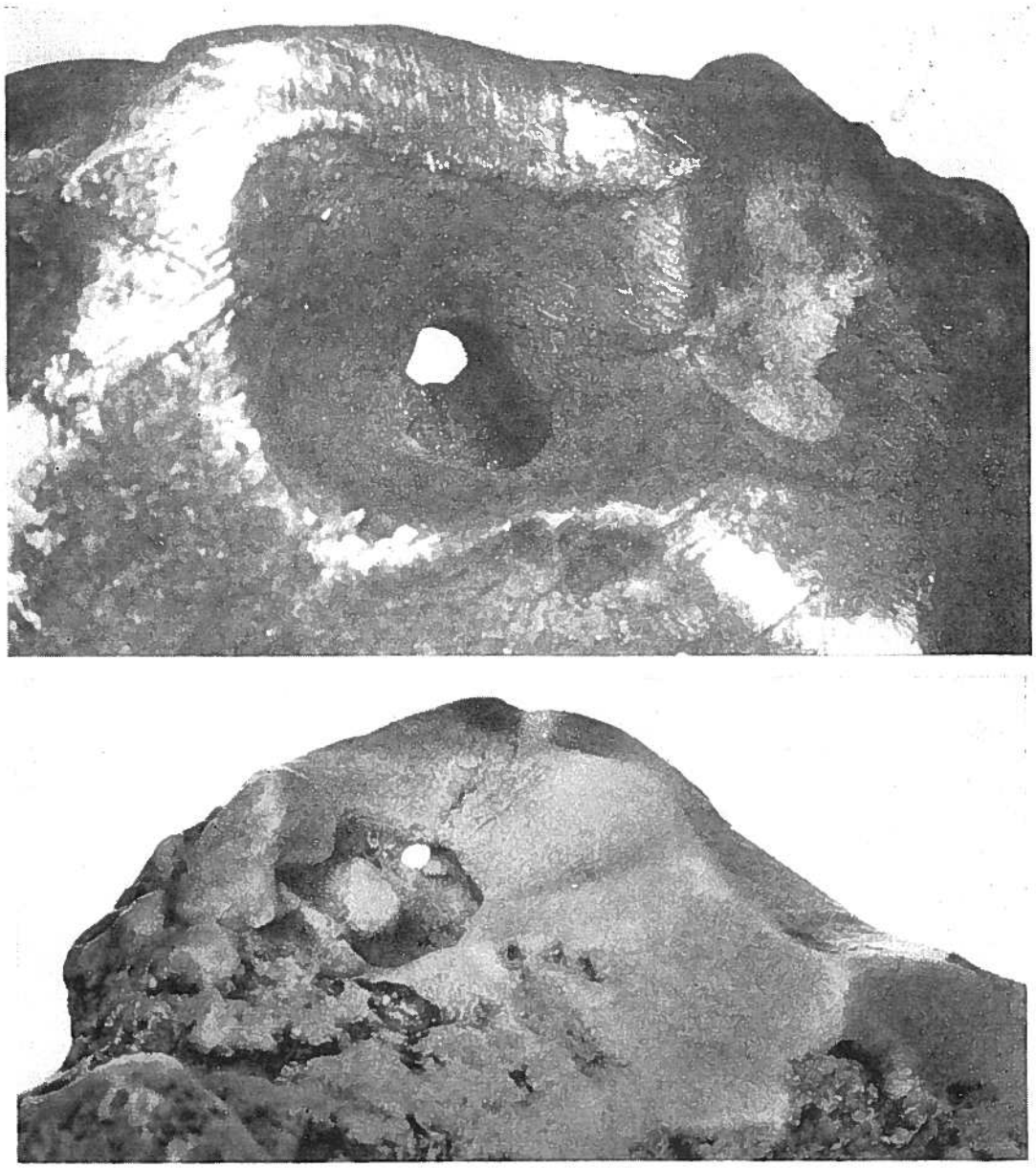
McCallie, S. W., 1922. The Pitts Meteorite. The Amer. Journ. of Sci., Vol. 3, pp. 211-215.

Perry, S. H., 1944. The Metallography of Meteoritic Iron. U. S. Nat. Mus. Bull. 184, p. 93.





Opposite sides of the Pitts meteorite. The metallic areas, which stand out in relief, show the usual sculpturing of iron meteorites. Shallow irregular depressions in the metallic phase are separated by rounded ridges. The rough areas consist of silicate minerals and troilite.



The upper picture shows a hole through the Pitts meteorite. The portion that is out of focus is where the focal length of the lens is less than the distance between the rim on the meteorite and the hole. The markings and the rim of overhanging metal around the hole are discussed in the text. The lower picture shows the same hole from the opposite side. The upper picture is 8X and the lower one 3X.

14. Pulaski County

In the fall of 1955, Mr. John Peterson of Hapeville, Georgia, brought to the Department of Mines, Mining and Geology in Atlanta, Georgia, a 116 gram piece of metal he found in a pasture in Pulaski County. Its metallic nature indicated that it was a meteorite thus Furcron referred it to the U. S. National Museum to be compared with some of the other iron meteorites from Georgia.

All the authors know about this new find is given here. We assume the sample came from the place designated by the finder and that the absence of further information means that no additional samples have been found. Since two years have passed and nothing more has been learned about this discovery we are releasing this information in hopes that someone will search this area for specimens of this meteorite.

Although the sample Mr. Peterson found was small and partly altered he consented to having one of its faces polished for study. The average width of the kamacite lamellae on this surface was 1.3 millimeters, thus, this iron is tentatively classified as a coarse octahedrite. A few small cohenite inclusions are present. There was not enough material to properly compare this discovery with the other iron meteorites but the nearest known iron to where this new fall was discovered is the Sardis iron. The two localities are about 100 miles apart.

The coordinates of the point of discovery of the Pulaski County iron are approximately 32° 15′ N. and 83° 30′ W. and those of the Sardis iron are 32° 57′ N. and 81° 52′ W. The Sardis iron is also a coarse octahedrite and contains no cohenite, however possibly cohenite is present as it is a common mineral in coarse octahedrites. The kamacite bands in

The fine octahedral pattern of this iron extends throughout the entire specimen. Numerous plessite areas are present but the most conspicuous feature is the almost parallel arrangement of the large irregular kamacite areas. Around these there are wide taenite bands. These large kamacite areas formed at a different time than did the fine kamacite lamellae in the matrix. The fractures which extend across this iron follow the kamacitic lamellae.

the Pulaski County and the Sardis are different so we consider these two meteorites are different.

Mr. Peterson who was asked to look for more specimens has not reported any new discoveries. The sample, identified as the Pulaski County meteorite, was returned to him.

15. Putnam County

This 72 pound iron, a fine octahedrite, was found in 1839 but it was several years before it was recognized as a meteorite. When an attempt was made to raise the sample they found it was unusually heavy, hence the finders were curious about its composition. The sample was carried to a blacksmith for testing and because the smith had such difficulty in breaking it, the object was set aside where it remained for several years.

According to J. E. Willet and C. U. Shepard, 1854, it weighed 60 pounds when finally presented to Mercer University, Macon, Georgia.[1] They further stated, ". . . in shape it represents a rude triangular pyramid with its base and edges rounded and its faces exposing many knobs and

[1]A recent communication from Mercer University, Macon, Georgia, reports that the whereabouts of this meteorite is unknown.

depressions." The polished and etched surface of the specimen in the U. S. National Museum Collections shows a fine octahedrite structure.

The fine octahedral pattern is interrupted with irregularly shaped, elongated kamacite bodies which are enclosed by broad taenite bands. Similar conspicuous coarse kamacite areas occur in octahedrites and are not fully understood. These features are unrelated to the fine octahedral pattern which surrounds them. The coarse areas possibly transformed at a higher temperature than the narrow kamacite lamellae in the groundmass.

Features such as described above occur in other meteorites such as the: Edmonton, Kentucky; Iron Creek, Alberta, Canada; Ivanpah, California and others.

Thin taenite bands surround the fine kamacite lamellae and thicker taenite bands encompass the larger irregular kamacite bodies. There is more plessite in this iron than is evident at first glance because the colors of both the kamacite and plessite are nearly the same.

The illustrated specimen is nearly an inch thick. The fractures which almost cross the etched face follow the octahedral pattern as do the cracks near the edge of this slice. The main fracture extends through this thick slice but the others do not. How these cracks were made is a matter of some interest. Since the etched structures on the opposite sides of the main fracture show no off-setting, the fracture probably is not a primary feature. These could have formed when the meteorite struck the ground or they could represent weathering but more likely these were made by the smith, who tried to break the specimen.

Cohen, 1905, published the following analysis of the Putnam County iron:

Fe	Ni	Co	Cu	Cr	S	P	Analysts
90.28	7.89	0.79	0.07	0.17	0.25	0.11	Baauer and Berger

Specimens of the Putnam meteorite are in the following collections:

U. S. National Museum	2,712 grams	Washington, D. C.
Harvard University	2,311 grams	Cambridge, Mass.
American Meteorite Museum	1,387 grams	Sedona, Arizona
Yale University	397 grams	New Haven, Conn.
Chicago Museum of Natural History	54 grams	Chicago, Illinois
American Museum of Natural History	37 grams	New York, N. Y.
Boston Society of Natural History	(not given)	Boston, Mass.
Naturhistorischen Hofmuseum	136 grams	Vienna, Austria
British Museum (Natural History)	112 grams	London, England
Academy of Sciences	28 grams	Moscow, U.S.S.R.
Museum d'Histoire Naturelle	26 grams	Paris, France
Museo de Madrid	41 grams	Madrid, Spain
University of Strasbourg	22 grams	Strasbourg, France
University of Bonn	4 grams	Bonn, Germany
Hungarian National Museum	21 grams	Budapest, Hungary
Vatican	1 gram	Vatican City, Italy

REFERENCES

Cohen, E., 1905. Classification und Nomenclatur; Kornige bis dicht Eisen; Hexaedrite; oktaedrite mit feinsten und feine Lamellen; Meteoriten Kunde. Heft 3, pp. 343-345.

Willet, J. E., and Shepard, C. U., 1854. Description of meteoric iron from Putnam County, Georgia. Amer. Journ. Sci. (2), vol. 17, pp. 331-332.

16. Sardis, Jenkins County

The Sardis iron was found in Jenkins County but was named after the nearest town, Sardis, which is in Burke County. This altered iron might be one of the oldest meteorites, having fallen in Miocene times, however, this cannot be proven. This rusty old meteorite was discovered in 1940 by a farmer plowing a field which had been continuously under cultivation for more than fifty years.

Those who had farmed this field for scores of years could not recall a depression or a crater where the iron was found. The plowman who snagged his plow, was curious about what was there, as he had visions of someday locating buried treasure. He hoped that the object which caught his plow would bring him luck. After considerable digging he satisfied himself that nothing of value was hidden either around or beneath the mass. Realizing it was heavy, he dug a deep hole under it and buried the object so his plow would not hit it.

A small piece that was broken off was later identified as an iron meteorite, so the main mass had to be re-excavated. This meteorite was partly discussed in the introduction, and what was said there will not be repeated here. Although its date of fall is unknown, everybody agrees that the Sardis iron is an old fall.

When the specimen arrived at the U. S. National Museum it measured 33 by 28 by 12 inches, but its shape and dimensions are not important because its form had been modified by weathering. The specimen, including the material attached to it, weighed 1,760 pounds and did not look like a meteorite, (see illustration). The object shown in the illustration is altered meteorite, enclosed in sandy material. The grains of sand are bonded together and onto the meteorite with secondary brown iron and nickel oxides.

Although this iron was found near some of the elliptical bays which have by some been called meteorite scars, Henderson and Cooke, 1942, do not believe there is any relationship between the meteorite and these bays.

A sizeable piece of altered meteorite was found when the main mass was excavated and the unaltered metallic iron within it is shown in an accompanying illustration. The etched pattern of the iron is that of a coarse octahedrite and a chemical analysis, made upon a portion of the metal removed from this piece, is as follows:

Fe	Ni	Co	P	S	Analyst
92.08	6.69	0.47	0.24	trace	Henderson

This meteorite decomposes quickly. Although the iron was bright when the picture was made, within three months it had oxidized to a pile of unconsolidated brown iron oxide.

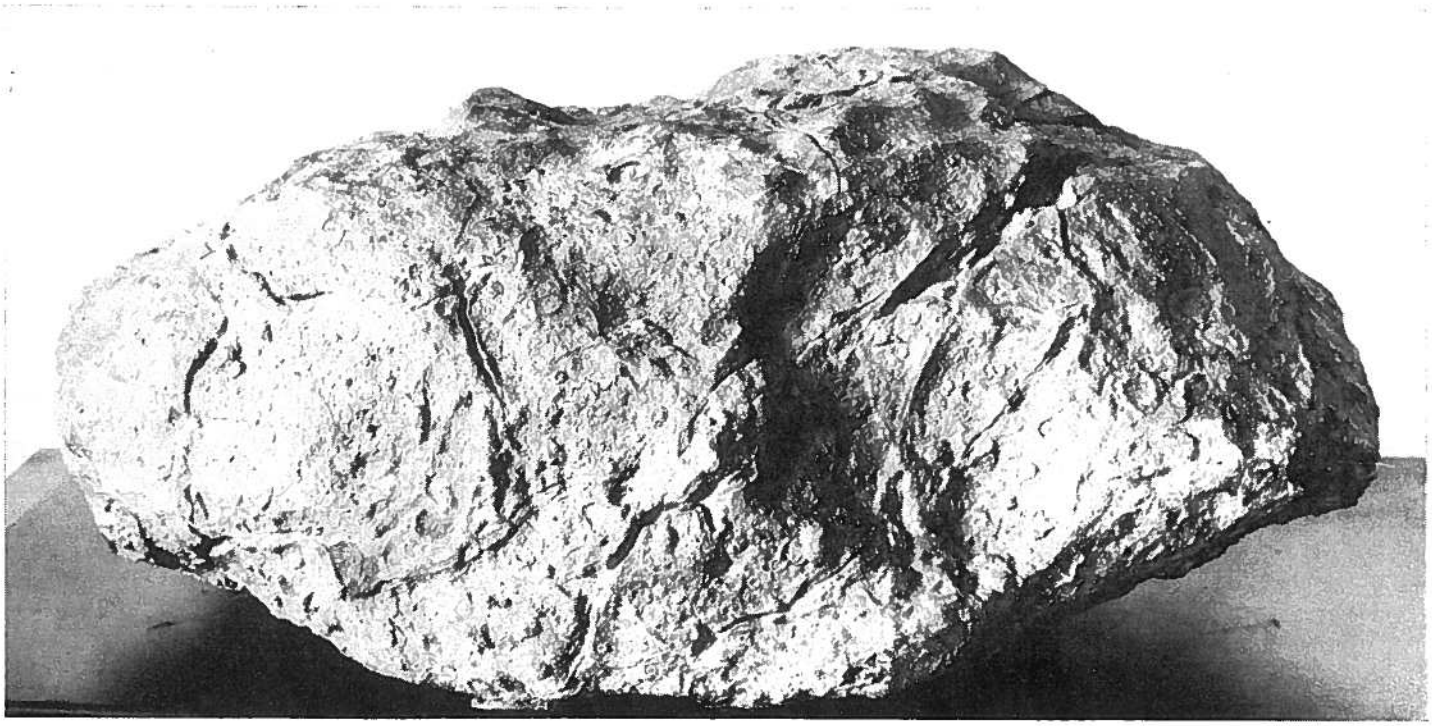
Buddhue, 1944 and 1957, published the following analyses of the alteration products.

The composition of the alteration products of the Sardis meteorite.

	1 (1944)	2 (1957)
FeO	16.75	18.30
Fe_2O_3	58.67	64.40
NiO	4.63	5.60
CoO	0.70	0.76
H_2O—	2.86	3.13
H_2O	7.96	8.70
CaO	0.30	
Cr_2O_3	0.02	
P_2O_5	1.28	
SO_3	0.89	
Insol.	4.68	
Pt.	0.30 oz/ton	

Buddhue had these comments on analysis one, ". . . The Sardis oxide contained also some chlorine and the determination of platinum metals in it was made on a sample containing a considerable proportion of metal. It should be noted that, since the Sardis oxide was formed largely since its excavation, it is very rich in FeO . . .".

Buddhue's comments on analysis two, ". . . One apparently solid piece weighing about five pounds completely disintegrated in the museum in about three months time. Analyses . . . . refers to the resulting "fresh oxide." An abundance of large particles of metal were removed, but some minute particles may have escaped and could account for the unusually large amount of FeO. The rapid oxidization suggest lawrencite but this mineral was not mentioned in the original description nor was the metal analyzed for



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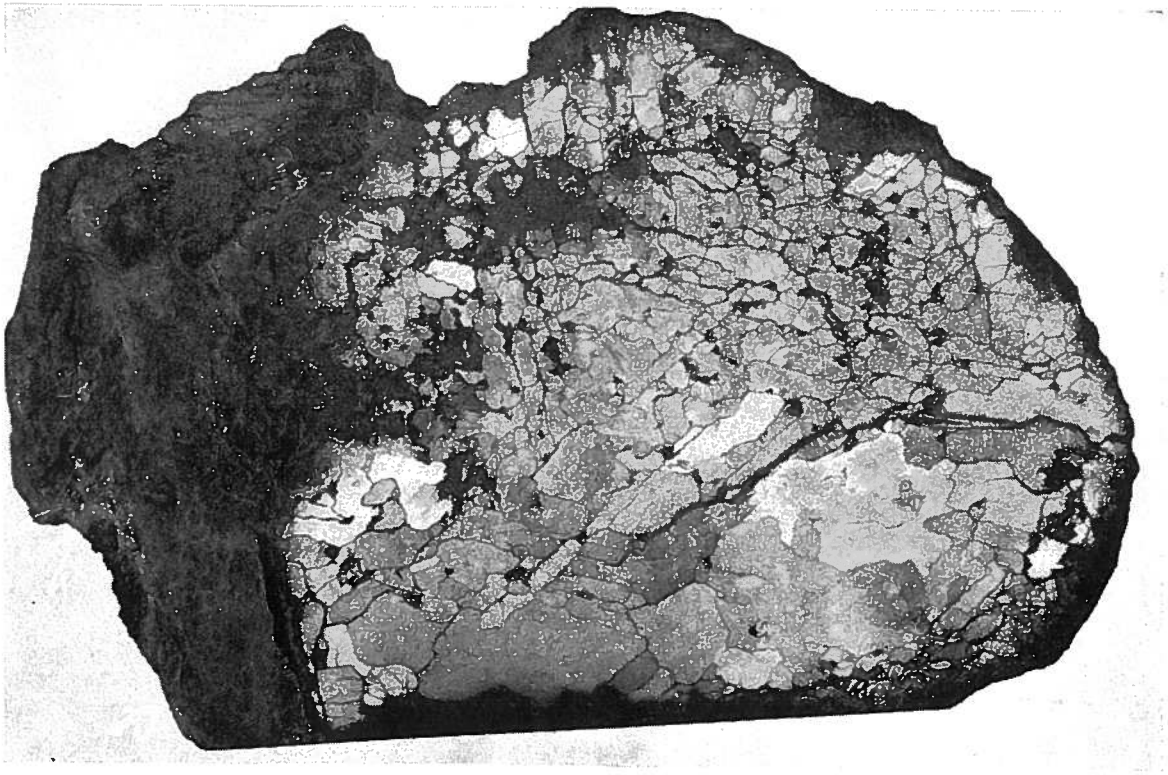


B

A. This sample measures 33 x 28 x 16 inches high and does not even resemble a meteorite. As its alteration products diffused through the surrounding sand precipitation occurred and bonded the grains to the meteorite. Possibly, the surface fractures represent some volume adjustment that occurred as the enclosed meteorite altered.

B. The coarse kamacite grains are separated by fractures which are partly filled with oxide. The dark area at the left is a side of the meteorite that is below the plain or the polished face. This specimen decomposed to unconsolidated rust within 6 or 8 weeks after this surface was prepared. Natural size.

A photograph of the second section cut from the Smithonia iron, taken at oblique illumination to show the Neumann lines. Since Neumann lines were not noticed in the first cut, this iron was described as a nickel-poor-ataxite. In places where the Neumann lines disappear before the edge of the section is reached we assume that externally applied heat obliterated these lines. Although the meteorite was badly weathered when found, apparently not much metal was lost from this area because the widths of the places that are free from Neumann lines are about the same as the thermally altered zones found around other iron meteorites. Natural size.

chlorine. However, good positive tests for chlorine and nickel were obtained in a distilled water extract of a small lump of oxide. Zaratite was also noted. The analysis, as expected, shows no significant change in nickel content but it probably would have if the old oxide had been analyzed."

There is a possibility that this iron fell into the ocean and if true it was wet with sea water. But there is another possible source for the chlorides. The material analyzed came from the mass shown in the accompanying illustration and was cut in the laboratories of the U. S. National Museum on a saw where the abrasive was washed onto the cutting band with tap water. The Washington city water contains chlorides and since the cutting rate of the band saw is slow this specimen could pick up considerable quantities of chlorides. This meteorite contained numerous fractures and had a porous oxide coating, thus, an appreciable amount of the chlorides in the alteration products might have been introduced during the cutting operation.

The exact size of the Sardis meteorite will never be known but it was a large iron and apparently the largest so far found in the southeastern states. The main mass of this meteorite is in the U. S. National Museum.

REFERENCES

Buddhue, J. D., 1944. The Formation of Meteoritic Iron oxide. Pop. Ast., vol. 52, pp. 346-354.

————, 1957. The Oxidation and Weathering of Meteorites. University of New Mexico Publication in Meteoritics, No. 3, pp. 122-123.

Henderson, E. P. and Cooke, C. W., 1942. The Sardis (Georgia) Meteorite. Proc. U. S. Nat. Mus., vol. 92, pp. 141-150.

17. Smithonia, Oglethorpe County

This weathered iron meteorite, a hexahedrite, was found about 1940 by Corbett Simmons. In correspondence with the U. S. National Museum and the Chicago Museum of Natural History, Mr. Simmons said it was found about 15 miles from Athens in Oglethorpe County, Georgia.

The iron was purchased by the Chicago Museum and described by Roy and Wyant, 1950. The specimen, when found, had already separated along some of its cleavages, thus, it had an unusual appearance for an iron meteorite. It weighed 154 pounds when received at the Chicago Museum but a substantial amount had been lost by weathering.

Chemically, the Smithonia iron agrees with the other hexahedrites and the analysis is as follows:

Fe	*Ni*	*Co*	*P*	*S*	*Analyst*
93.43	5.58	0.68	0.20	0.10	Wyant

When this meteorite was described, its structure was examined on a section from near the surface. As that piece had none of the orderly arrangement of hexahedrites, Roy and Wyant, 1950, concluded it was a nickel-poor-ataxite. However, when the section, here illustrated, was received in exchange by the U. S. National Museum, it was polished and the inner portion displayed Neumann lines. This meteorite should be listed as a hexahedrite rather than a nickel-poor-ataxite.

The main mass is in the Chicago Museum of Natural History. Five hundred seventy-four grams are in the U. S. National Museum, Washington, D. C.

REFERENCES

Roy, S. K. and Wyant, R. W., 1950. The Smithonia meteorite. Geol. Series, Field Museum of Nat. Hist., vol. 7, pp. 129-134.

18. Social Circle, Walton County

This 219 pound iron deserves more recognition than it has received, because it is uniformly granulated throughout. Some iron meteorites display a degree of granulation but we seldom know that the modified structure extends through the entire iron. This iron apparently was reheated since it originally cooled and before it entered our atmosphere. Many irons, when sectioned, show evidence of secondary reheating near their surfaces. The uniform granulation, shown in the accompanying illustration, indicates that it was not reheated above a comparatively low temperature.

The Social Circle iron was recognized in 1926 on the W. B. Spearman's plantation in Walton County, Georgia. It had been in the possession of the family for several years before the state geologist of Georgia, S. W. McCallie, acquired and described it.

This iron, when discovered, had the appearance of an old fall. Its surface had weathered to a point that all of the flight crust had vanished. Although it is impossible to estimate when this iron fell, it may not be an old fall because this meteorite happens to be one that alters rather rapidly.

The Georgia Department of Mines, Mining and Geology, kindly loaned the meteorite to the U. S. National Museum several years ago where it was cut and examined by Henderson and Perry, 1951. The iron was cut in half, essentially parallel to its long dimension. Next, several slices were taken from one of the halves at right angles to the direction of the first cut. By etching these different surfaces it was determined that the 219 pound iron was uniformly granulated.

Everhart's analysis did not conform to the view of Perry and Henderson regarding the relationship of the etched structure. The percentage of nickel reported from this iron was not agreed upon so a re-analysis was made.

Composition of the Social Circle Meteorite

	Fe	*Ni*	*Co*	*Cu*	*Sn*	*P*	*Analyst*
1.	94.07	5.02	0.35	trace	0.09	0.09	Everhart
2.	91.83[1]	7.44	0.38	n.d.	n.d.	trace	Henderson
3.	92.06[1]	7.44	0.50[1]	.....	.....	.....	Henderson

The Fe, Ni, and Co values in analysis number three are consistent with analyses of other octahedrites which have similar structures. The kamacite bands in this iron have an average width of between 0.3 and 0.5 millimeters and are separated by well defined taenite lamellae. Other than a few small troilite and schreibersite bodies no noteworthy inclusions were seen in this iron. If this meteorite is classified by its widths of kamacite bands it is a granulated fine octahedrite.

The granulation shown in the accompanying illustration indicates that the reheating was limited to the lower temperatures needed to produce structural changes in iron meteorites. However, it is impossible to establish when, where, or what the temperature was to which this iron was raised. All nickel-iron diagrams show the solubility of nickel in iron decreases as the temperature is raised. So, in the reheating of a meteorite the first changes occur in the kamacite. In this case the kamacite lamellae are granulated but the taenite lamellae, separating the kamacite bands, are unchanged. Kamacite granulates before taenite disappears because its ability to retain nickel in solution decreases much more rapidly than taenite as the temperature is raised.

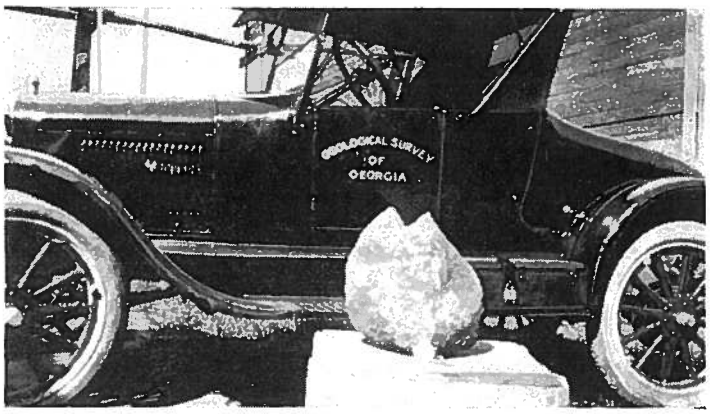
Because of the size of the Social Circle iron its thermal alteration occurred outside the atmosphere and not in the seconds required to fall through the air. Although our present knowledge about thermal penetration during flight is far from being satisfactory, existing evidence shows that the only changes made are those limited to a zone of a few millimeters at the surface of the meteorite.

The usual heating a meteorite receives in forges, burning buildings, or in fireplaces does not materially alter its internal structure. Although man could heat treat an iron meteorite and produce these changes, it requires more equipment than is available to the average man, so we believe the thermal changes noted in this meteorite were made outside our atmosphere.

The reheating of this iron occurred after these kamacite bands formed. Although the iron could have been heated to a very high temperature for a limited interval, it is more logical to assume that it was heated to a comparatively low temperature for a longer period of time.

Recently, a sample of the Glorieta, New Mexico, iron was heated in the laboratories of the U. S. National Museum for 25 hours at 750° C. During the treatment no appreciable changes occurred in the structure that could be detected by the unaided eye. A well defined kamacite lamellae remained and the kamacite was not granulated. Molecular migration at 750° C. is sluggish and 25 hours of heating at this temperature was not enough to produce features such as one sees in the heat treated zones around some of the iron meteorites.

The Glorieta iron contains 11.79 percent Ni while the Social Circle iron has only 7.44 percent Ni. There is a large difference in the nickel content of these two meteorites. Thus, the Glorieta which contains the most Ni should be more sensitive to changes at lower temperatures than the iron in the Social Circle meteorite.



SOCIAL CIRCLE

This is the appearance of the Social Circle meteorite when it was picked up by State Geologist S. W. McCallie May 1926. The notch represents iron removed by a colored man who used 11 hack saw blades. McCallie's original analysis of nickel was made from this removed section.

The taenite lamellae in the Social Circle (see illustration) are well defined and continuous throughout the specimen. If the temperature was sustained very long, the taenite lamellae probably would not be as well defined as they are. The habit of the taenite in this meteorite is rather good evidence that the temperature to which this iron was reheated was a moderate one.

Dr. Charles P. Olivier[1] states that some astroids have orbits that take them inside the orbits of Venus and one or two of them inside the orbit of Mercury. Thus, many meteorites may have these same orbits, and possibly the Social Circle iron had an elliptical orbit with a perihelion distance near enough to the sun to be reheated.

[1]Since the re-analysis of the Sardis iron was made, others have found that the cobalt in iron meteorites averages about 0.50 percent, thus, this amount is taken in place of the 0.38 percent reported in the re-analysis. Using 0.50 and 7.44 for cobalt and nickel respectively iron was determined by difference.

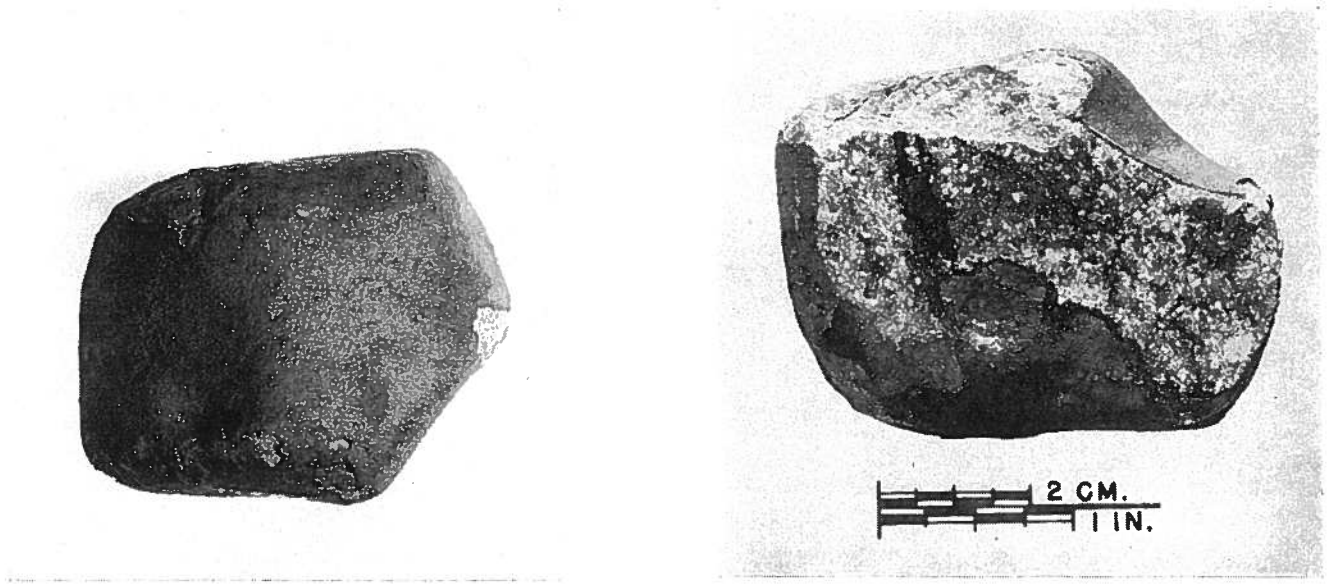
[1]Personal communications.

A

B

A. A section through the Social Circle iron showing a uniform structure. If a straight edge is slid over this picture, parallel to the structure, the entire area has the same crystallographic orientation. Small rounded troilite inclusions are present but the irregular dark areas near the edge represent secondary iron oxide weathering. All the original flight surface is gone, so, only a guess can be made about the orientation during its fall. Possibly the upper side was the forward face, however, this assumption is based upon the shape of this cross section. 44 per cent reduction.

B. The thin ridges, separating the granulated narrow bands, are taenite. The granulated portion, kamacite, probably once had a homogeneous crystalline structure but during reheating the meteorite received, this granulated texture developed. If the temperature attained during that reheating was high the taenite bands would have disappeared.



A B

A. A typical black fusion crust on a freshly fallen stony meteorite. Natural size.

B. A polished surface showing a gray interior containing thin black glassy veins, also a large black glassy area. Numerous small metallic inclusions of both nickel-iron and iron sulfide (troilite) occur in the gray groundmass. The same inclusions are found in the large black body. Note the sharp contact between the fused crust and the gray interior.

Specimens of the Social Circle meteorite are in the following collections:

U. S. National Museum	1,377 grams	Washington, D. C.
Georgia State Capitol Museum	Main Mass	Atlanta, Ga.

REFERENCES

Henderson, E. P. and Perry, S. H., 1951. A Restudy of the Social Circle, Georgia, Meteorite. Amer. Min., vol. 36, pp. 603-608.

McCallie, S. W., 1927. Notes on the Social Circle Meteorite. Amer. Journ. Sci. (5), vol. 13, p. 360.

19. Thomson, McDuffie County

This 234 gram stony meteorite, a chondrite, was acquired by the U. S. National Museum in 1909 from George H. Plant of Macon, Georgia. Little is known about its early history because it had been in private hands for many years before Mr. Plant obtained the specimen.

The Thomson meteorite was described by G. P. Merrill, 1909 who refers to a letter from the finder, B. F. Wilson to I. C. Plant of November 26, 1888, which stated, ". . . . The stone sent you was picked up by the undersigned on October 15th, four miles south of Thomson. It fell within thirty yards of where the writer was at work." Merrill continues, ". . . Mr. Wilson was picking cotton at the time, and his first impression was that someone had thrown a huge stone at his head. He then noticed where the meteorite fell, some thirty steps away. It was buried some six or eight inches in the earth and he dug it up with a spade. Only one stone fell."

This small stone at the end of its trajectory was falling so slowly that it made no sound. Possibly sounds were heard elsewhere as the meteorite streaked through the sky. Several meteorites have fallen very close to observers without any sounds being made to alert a person that such an important event was about to happen.

Although our examination of this specimen was made after the polished face shown in the accompanying picture was made, it is possible to establish how the stone was orientated at the end of its high velocity flight. Around the edges of the face that is covered with the fusion crust (see illustration) there are some delicate flight features which show that this was the rear face.

Where the crust is missing on the polished face, the gray interior of the stone can be seen and the circular outline of some chondrules. Merrill reported that the two chief constituents are enstatite and olivine. One can easily recognize troilite and nickel iron in this enstatite.

Some of the numerous narrow, black veins which occur within this meteorite can be seen in the illustration showing the polished surface. A few of these veins are also visible where the flight crust is missing. Similar black veins in other stony meteorites have been investigated and they seem to have about the same chemical composition as the groundmass in which they occur. These veins consist of black, glassy material which possibly represents the fusion of material similar to the enclosing groundmass. Although these are called veins, there is a distinction between these and a vein in terrestrial rocks. Usually a geologist thinks of a vein as having a different chemical composition than the rock enclosing it, but veins in stony meteorites are essentially the same as the enclosing groundmass.

The large black band in the accompanying illustration contains inclusions of troilite and nickel-iron. Actually, these minerals are about as abundant in the black band as they are within the gray portion of the meteorite. The wide, black band of glassy material, and the smaller veins we believed existed before the stone entered our atmosphere. We suspect these veins were fractures through which some molten material flowed. This could not take place during the time this object was a small mass traveling in space or during the interval it passed through our atmosphere. These must have occurred when this meteorite was a part of the parent body in which it was made, because the mechanics of making these veins is inconsistent with anything that is likely to happen while a meteorite is in flight.

These small veins could not be filled with glassy material unless the enclosing gray material was also quite hot. Also,

the glassy material must have been hot enough to flow easily through small cracks. If the matrix was cooler than the molten material, the latter would not penetrate far into narrow openings.

The thickness of the black fusion crust can be seen around the edges of the polished face. Usually the crust is thin on the front face but it may thicken at the contact of the front and rear faces.

The only specimen of the Thomson meteorite is the 234 gram specimen in the U. S. National Museum, Washington, D. C.

REFERENCE

Merrill, G. P., 1909. A Heretofore Undescribed Stony Meteorite from Thomson, McDuffie County. Smith. Misc., vol. V, pp. 473-476.

20. Twin City, Emanuel County

This altered nickel-rich ataxite was found by Joe L. Drake while working for the Emanuel County Highway Department in 1955 and was recognized as a meteorite by Furcron and Henderson. The meteorite was found eight miles due east of Twin City and the intersection of U. S. 80 and Georgia 123. It was picked up in front of the home of Ben Robert Gay on the west side of the county road, 1.2 miles west of the Bulloch County line, and 1.75 miles airline S 59° E of St. Paul's Church. Mr. Drake, at the time, was scraping the road and the object was found loose in front of the scraper. Thus, it is possible that it had been pushed northwestward to the discovery point for as much as 50 yards. At this place the country is quite sandy and the fields on both sides of the road are about at road level. Circumstances connected with its discovery would indicate that it could not have been buried more than a few feet at most and that it fell in sand.

Mr. Drake took the specimen home and a small sample of it was later sent to the Georgia Geological Survey by his son Billy. At the time of its discovery it was thought that it might represent a variety of rare metal, possibly gold. Thus the meteorite was beaten considerably with a hammer and inasmuch as this specimen was considerably weathered, a good deal of damage was done.

The total weight of the specimen which was purchased from Billy Drake was 11 pounds, 3 ounces, but the appearance of the specimen would indicate that a piece had dropped off or come off, possibly when it was beaten, which might amount to as much as a third of the present weight. Also, a small fragment weighing 60.25 grams was later purchased from a little girl and is now in the collection of Hugh Howard of Atlanta.

The specimen, received in Washington, had little loose oxide attached to it but it was badly fractured. In places, some freshly broken surfaces indicated that some pieces were missing. Although we do not know how much was lost, we are told that the specimen received represents the bulk of what was found.

The Twin City iron when sectioned in the U. S. National Museum's laboratory was found to consist of large grains interlocked with one another because of their irregularities. Since many of the grains were separated by open fractures it was impossible to get a complete cross section through this iron. The polished surfaces of these pieces quickly tarnished during the humid weather, indicating that the alteration products which covered the iron at the time it was found could have formed within a few years.

Nothing about this meteorite suggests it is a recent fall but some indirect evidence indicates that it possibly fell about 150 years ago. If true, the alteration products that were found on this iron must have inhibited further decomposition.

The numerous internal fractures, which prevented us from getting a cross section, may have been opened in the beating this iron received. However, the alteration products which form between the grains of some iron meteorites might exert enough force to separate the mass. At least many of the weathered coarse granular meteorites have veins of oxide between the grains and often open cracks separate these grains.

Unfortunately, the manner in which the Twin City iron was found made it impossible for the authors to get detailed information about the following: (1) Was the iron completely buried in the soil or was it partly exposed? (2) Do additional pieces exist? (3) Soil samples from around the meteorite collected to determine the nickel profile would be not dependable in this sand.

A preliminary chemical analysis shows that this iron contains 29.91 percent Ni and 0.51 percent Co[1]. The sulphur and phosphorus content of the acid soluble portion is 0.046 and 0.34 percent respectively. About 2 percent of this meteorite is insoluble in dilute hydrochloric acid and most of the residue is a phosphide. Chemically this iron is similar to the Lime Creek, Alabama, meteorite which according to Knauber's analysis (Cohen 1905) contained 31.06 percent Ni.

The Lime Creek iron, like the Twin City specimen, was badly altered when discovered near Clairbourne, Monroe County, Alabama, 1834. According to Jackson, 1838, it was found on the surface of the ground, had an irregular triangular shape, with dimensions of about 10 inches long by 5 or 6 inches in thickness and "was too heavy for one man to carry conveniently." Jackson's description seems to describe the Twin City iron almost as well as it does the Lime Creek meteorite.

Both are small and extensively weathered irons, chemically similar and distinctly unique from all the known meteorites in the Southeast. Although the two localities, from whence these irons came, are approximately 300 miles apart, the similarity between these irons raises the old question, e. g., should the Lime Creek, Alabama, and the Twin City, Georgia, specimens be regarded as paired falls?

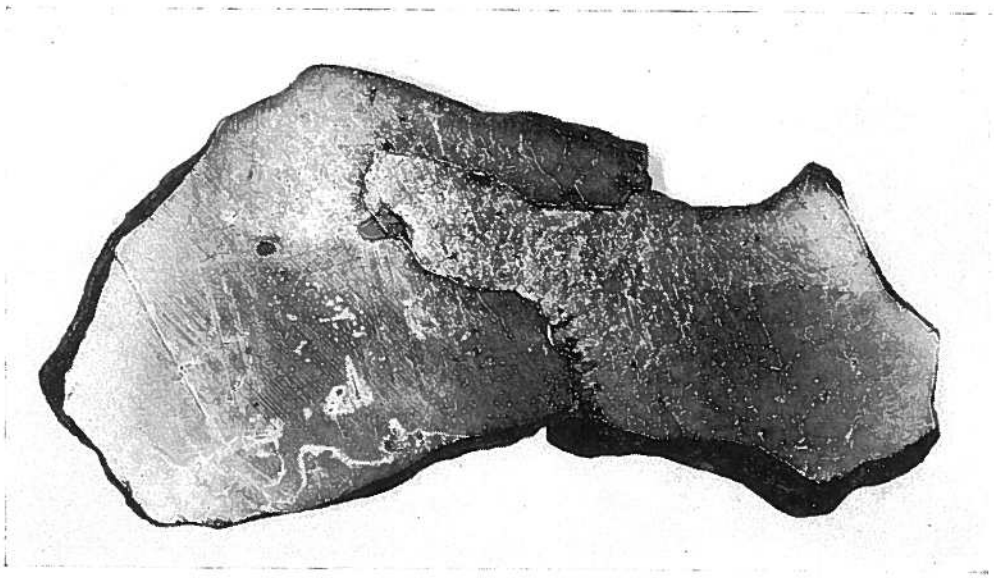
Because of these unusual high nickel percentages one is tempted to claim the two irons have a common origin. Certainly it would be a coincidence if these irons fell at different times and struck the earth within such a short distance of each other. Although such a thing could happen we prefer to assume that these two irons fell almost simultaneously.

The Lime Creek meteorite fell long enough before 1834 for it to become weathered. When it fell is anyone's guess but for convenience we have assumed that 25 to 30 years is enough time for the Lime Creek iron to acquire the amount of alteration it had at the time it was found. This pushes its fall back to about 1800.

Mention was earlier made about the alteration products that formed quickly on the Twin City meteorite when it was polished in the laboratory. This makes one wonder if it fell as long ago as 1800. However, iron meteorites that are exposed in nature seem to alter slower than the specimens that are stored indoors. Some irons, unless special precautions are taken alter faster after they are placed in a building than they do when they are unprotected in the field. One possible reason for this is the iron chlorides which form on the meteorite that is stored inside remain in contact with the iron and continue to attack the metal. Much of the iron chloride that forms on a meteorite that is out of doors is washed off by rain water.

Some of the samples of terrestrial iron in the U. S. National Museum which proved difficult to preserve within the Museum became relatively stable when exposed in an open court

[1]These figures were confirmed by Dr. Harrison Brown and his associates at California Institute of Technology.



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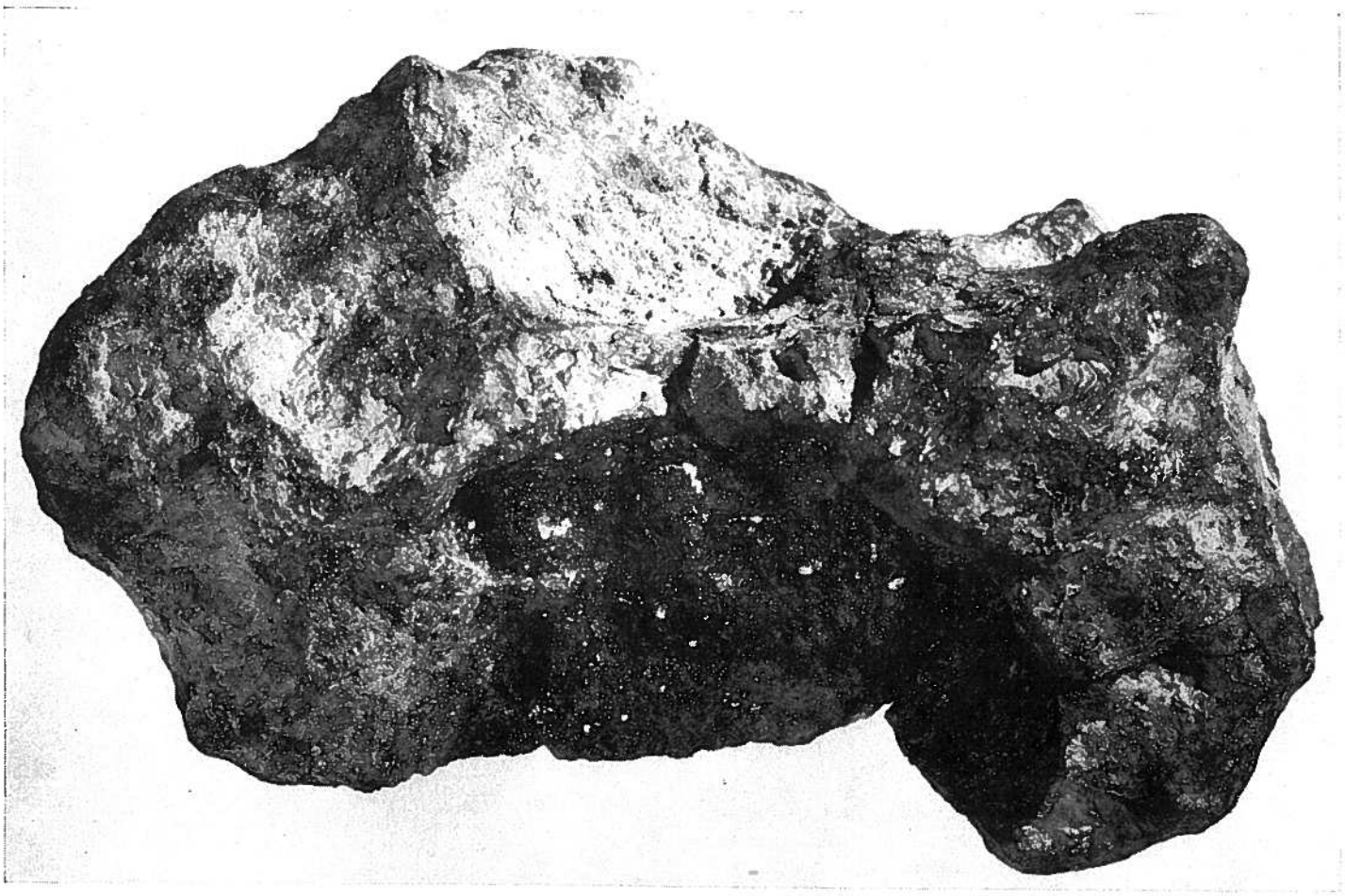
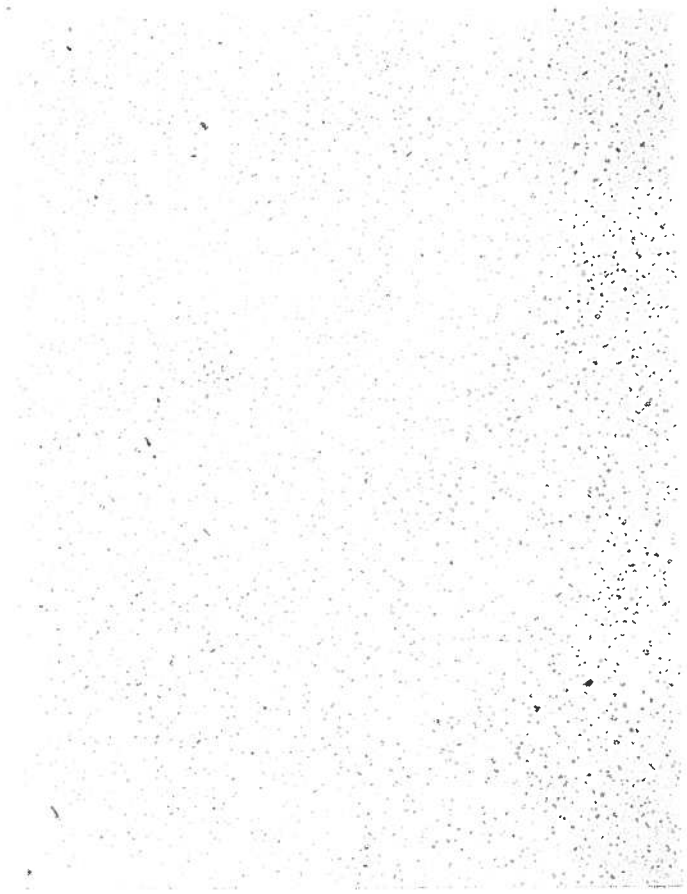


B

A. Polished surface showing two interlocking grains. This is but a portion of the cross section of this iron. Some precipitation occurred along the grain boundaries. Natural size, nital etching.

B. The altered surface of the Twin City meteorite. All the original flight markings have been lost. About natural size.

The lines extending from the lower right diagonally towards the upper left apparently are slip bands. Movement has occurred along these because the delicate lines which cross the heavy lines are curved. The diagonal black vein, through the center is filled with secondary oxide and represents an old fracture. The small angular inclusion in the upper right corner is schreibersite and the dark spots surrounding this body may be phosphide particles. 4 percent picral acidified—30 seconds—20x.



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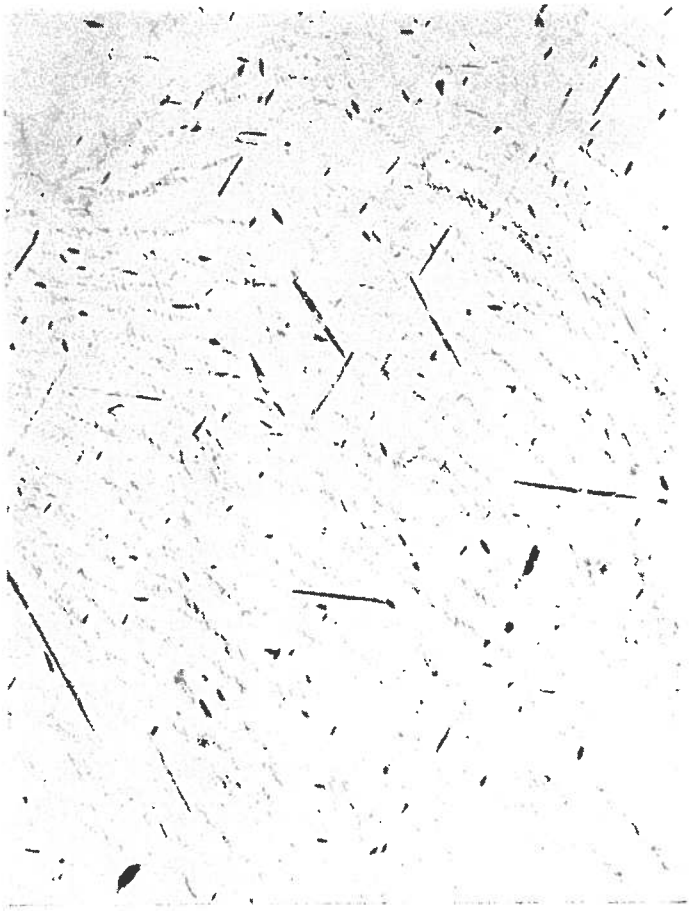

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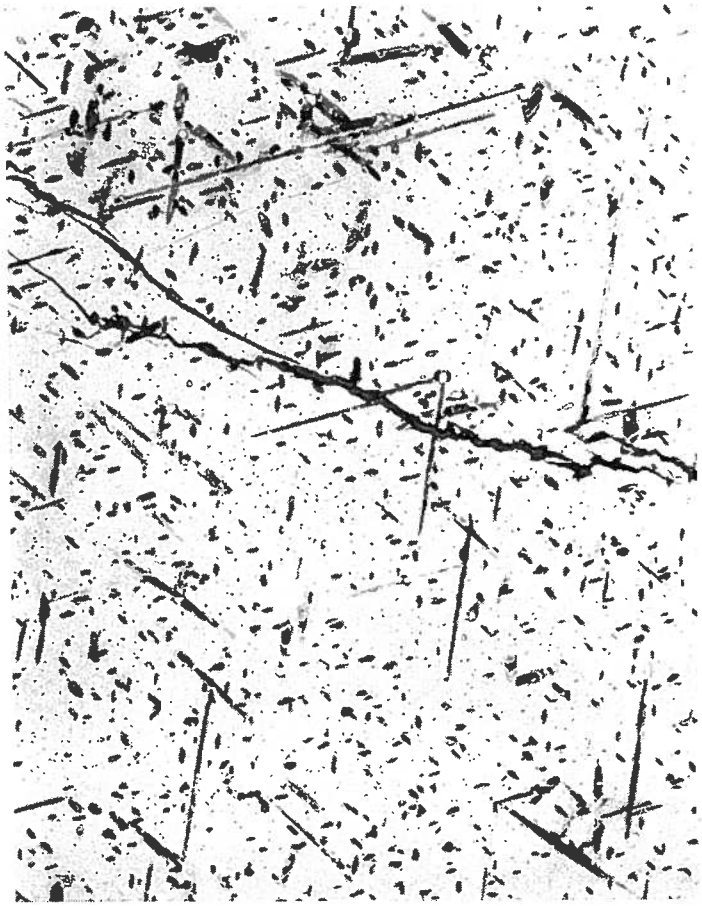

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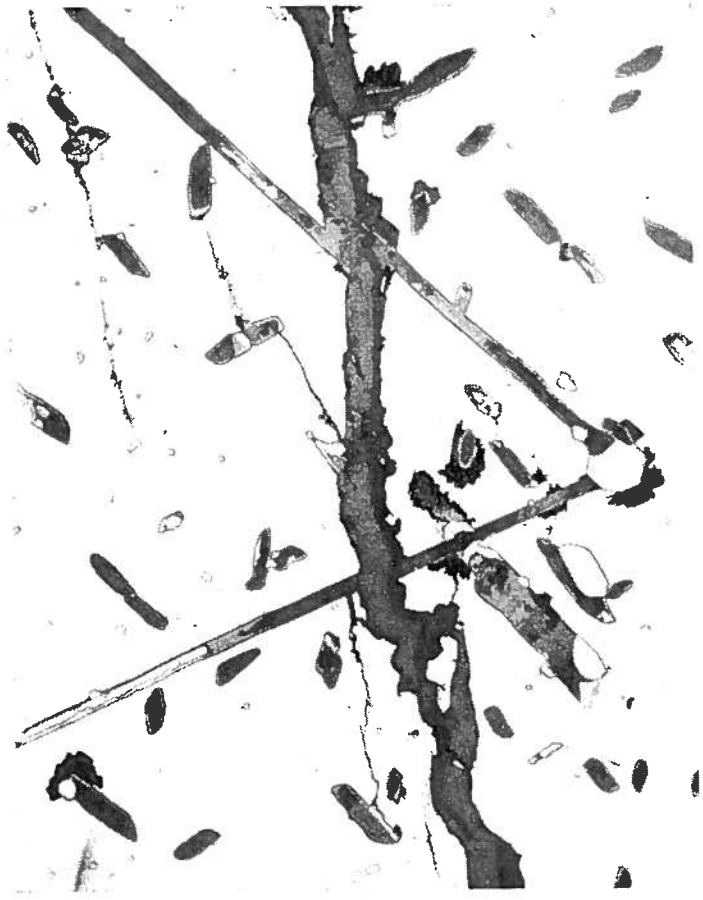

D

A. The rhabdite inclusions are partly rounded and since they usually have sharply defined sides it suggests that this iron was reheated and these inclusions began to dissolve in the matrix.
4 percent picral acidified with HCL—30 sec.—100x.

B. Oxidized needles of kamacite which are neither deformed or broken by any of the movement that took place within the iron. The finely divided dark bodies which make up the broken lines suggest some distortion occurred in the matrix. The kamacite needles intersect at approximately 60°. Unetched—100x.

C. Oxidized kamacite spindles produce a skeleton-like Widmanstatten pattern. Iron oxide fills a fracture extending across the entire area of the field but no appreciable displacement occurred along this fracture. 4 per cent picral acidified—30 sec.—100x.

D. Oxidized kamacite needles intersecting each other at approximately 60° at an angular phosphide inclusion. Some of the light colored portions within these kamacite spindles may be phosphide inclusions. The largest kamacite lamellae are slightly displaced at the fracture which is filled with iron oxide. 2 percent nital—15 sec.—500 x.

yard. Also, some meteorites which fell many years ago and seemed stable when found, decomposed at a rapid rate when placed inside.

The photomicrographs made by C. R. Simco, Battelle Memorial Institute, show numerous kamacite spindles arranged in a trigonal pattern in a taenite matrix. This structure, in some respects, is similar to what Perry, 1944, found for the Lime Creek iron. In two of the accompanying pictures, a series of parallel lines are shown within the meteorite. Although these are not fully understood they resemble Neumann lines that are common in kamacitic iron. The analysis of the Twin City meteorite indicates that its matrix is essentially taenite and most pictures of taenite show that it is free from Neumann lines.

Although the rounded phosphide bodies in one of the accompanying pictures suggests that this meteorite at sometime was reheated, this reheating if it occurred, must have happened before the Neumann lines were formed, because Neumann lines in kamacite are quickly obliterated by reheating and there is no reason to suspect that Neumann lines in taenite would be any more resistant to heat.

The main mass of the Twin City iron is in the collections of the Department of Mines, Mining and Geology, at Atlanta and one slice is in the U. S. National Museum in Washington, D. C. A 60.25 gram sample is in the private collection of Hugh Howard, Atlanta, Georgia.

21. Union County

Although there are samples of the Union County, Georgia, meteorite in many different collections, there is little definite information recorded about its history or composition.

Shepard, 1854, described a small piece he received weighing 1 pound 7¾ ounces, which came from an iron weighing about 15 pounds, from Union County, Georgia. He said, ". . . . It appears to have formed a portion of a somewhat tabular mass about 2 inches in thickness. It was coated on three sides with a thin scaly covering of brownish-black peroxide of iron." The other two sides present the appearance of fresh fracture. He observed that the iron did not give a Widmanstatten structure when etched.

This meteorite is a coarse octahedrite with large irregular areas of kamacite and without appreciable plessite. There are many coarse octahedrites which have structures like those which occur in the Union meteorite.

Brezina, 1885 and Meunier, 1893, both called attention to the resemblance of this iron with the one from Nelson County, Kentucky. There is no reliable analysis of the Union County meteorite.

Specimens of the Union County iron are reported in the following collections:

Amherst College	2,225 grams	Amherst, Mass.
American Meteorite Museum	343 grams	Sedona, Ariz.
U. S. National Museum	118 grams	Washington, D. C.
Yale University	216 grams	New Haven, Conn.
American Museum of Nat'l History	59 grams	New York, N. Y.
Chicago Museum of Nat'l History	67 grams	Chicago, Ill.
Harvard University	35 grams	Cambridge, Mass.
Université de Strasbourg	141 grams	Strasbourg, France
British Museum (Natural History)	98 grams	London, England
Museum d'Histoire Naturelle	72 grams	Paris, France
Naturhistorischen Hofmuseum	16 grams	Vienna, Austria
Hungarian National Museum	4 grams	Budapest, Hungary

REFERENCES

Brezina, A., 1885. Die Meteoritensammulung des k. k. Mineralogischen Hofcabinetes in Wien am 1 Mai 1885, pp. 217, 234.

Meunier, S., 1893. Recision des fers Meteoriques de la collection du Museum d'Histoire Naturelle, p. 288.

Shepard, C. U., 1854. New Localities of Meteoritic iron. Amer. Jour. Sci. (2) vol. 17, p. 325-330.

GLOSSARY OF SCIENTIFIC TERMS

The technical terms used in this discussion are defined in this glossary and the numbers, which follow the definitions, refer to the following sources where additional information may be found if it is needed.

1. Any standard textbook on mineralogy.
2. Meteorites, O. C. Farington, 1915, privately published.
3. The Metallography of Meteoritic Iron, S. H. Perry, 1945, U. S. National Museum Bull. 184.

Acicular ..... Needle like crystals.

Ataxite ..... Iron meteorites after being etched that do not show an orderly arrangement of their structures. *Nickel-poor-ataxites,* iron meteorites with ataxitic structures which contain less than 6 percent Ni. *Nickel-rich-ataxites,* iron meteorites with ataxitic structures which contain considerable more Ni than most other iron meteorites. The lower and upper Ni percentages of this group are not sharply defined but usually there is more than 10 percent and less than 30 percent of Ni in these iron meteorites.

Cohenite ..... An iron carbide, Fe_3C which usually occurs as small irregular inclusions within the kamacite lamellae and is essentially found in the coarse octahedrites. (3)

Chondrite ..... A stony meteorite containing small rounded silicate inclusions called *chondrules.* These usually consist of enstatite, hypersthene, olivine, feldspars and some glass and have peculiar internal structures. Sometimes the individual chondrules are easily separated but usually are firmly bonded together. Their outside surface is rough. Chondrules, if present, usually can be recognized once the interior of the stone is exposed. They are conspicuous on polished surfaces or in thin sections. Terrestrial rocks do not contain chondrules. (2)

Diopside ..... A common mineral in meteorites and terrestrial rocks. Chemically, it is a calcium magnesium silicate and a member of the pyroxene group of minerals.

Eutectic ..... This is best explained by an example. Silver melts at 962° C. and copper at 1084° C. but an alloy made of 72 percent silver and 28 percent copper melts at 778° C. Thus, certain proportions of copper lowers the melting point below the normal melting point of silver. The lowest fusion point of such an alloy is the eutectic temperature, the structure of the product that forms at the eutectic temperature has a eutectic structure.

Feldspars ..... A common mineral in meteorites and terrestrial rocks. Chemically, the feldspars are silicates of sodium, potassium and calcium. Meteoritic feldspars usually are members of the sodium-calcium series, plagioclase feldspars. The most abundant meteoritic feldspar is near the calcium end of the plagioclase series. (1)(2)

Hexahedrites ..... Iron meteorites which are composed almost entirely of kamacite; usually, contain about 5.5 percent Ni and have one or more sets of Neumann lines. Hexahedrites often show cubical cleavage. (2)(3)

Kamacite ..... An essential constitutent in most iron meteorites. This Ni-Fe compound, alpha iron, occurs as a lamella in the octahedrites and as the main constituent in hexahedrites. Kamacite, usually, is enclosed with narrow bands of taenite. (2)(3)

Lamella ..... This is a band or elongated plate, lath-like body.

Lawrencite ..... Ferrous chloride, which forms as drops on the surface of meteorites. This material causes rapid disintegration of many irons and some stony meteorites.

Mesosiderite ..... This term is used in its true etymological sense and here it denotes a group intermediate between the irons and the stony meteorites and is not descriptive of the silicate minerals that are present.

Neumann lines ... Fine lines which appear on most of the etched surfaces of kamacitic iron. Neumann lines were made when some stress was applied to the metal and are parallel to any pair of faces of a tetragonal trisoctahedron, (trapezohedron) thus several sets of Neumann lines may be present. (2)(3)

Octahedrites ..... When the etched surface of an iron meteorite shows a net work of kamacite lamellae, so arranged, that their directions make a trigonal pattern which is parallel to the face of an actahedron, it is called an octahedrite. Irons which have octahedral habits are said to have a Widmanstatten pattern. The octahedrites usually contain between 6 and 12 percent of Ni. (2)(3)

Olivine ..... A common yellowish green mineral which crystallizes in the orthorhombic system and, chemically, is a magnesium iron silicate. Olivine occurs in both terrestrial rocks and in many meteorites. (1)(2)

Plagioclase ..... See feldspars.

Plessite ..... A structural component in octahedrites consisting of a mixture of kamacite and taenite. Often a plessite area will have delicate structures similar to the Widmanstatten pattern. Plessite fills the space between the octahedral network of kamacite lamellae. (2)(3)

Pyroxene ..... An important group of rock forming minerals in both terrestrial and meteoritic stones. (1)

Schreibersite ..... An iron, nickel cobalt phosphide. A common mineral in iron meteorites which has not been found in terrestrial rocks. Usually occurs as an irregular inclusion, has a tin white color, is brittle, resistant to etching reagents and is strongly magnetic. (2)(3)

Steadite ..... A product which is rejected from a solution of cast iron at a eutectic point. It consists of iron carbide, Fe_3C, iron phosphide, Fe_3P and grains of ferrite, pure iron. (3)

Swathing kamacite ..... A lamella of kamacite which surrounds inclusions in iron meteorites, usually showing no relationship to the other kamacite lamellae and conforming to the shape of the surrounded inclusion. Swathing kamacite is chemically different from the kamacite in the matrix of the meteorite. (3)

Taenite ..... A nickel rich alloy most frequently seen at the edge of a kamacite lamellae. Has a white color, is resistant to etching reagents and contains no Neumann lines. Taenite rarely is a homogeneous compound and where the taenite lamellae are widest, usually some dark taenite is enclosed. The Ni content of taenite varies possibly between 15 and 50 percent. (2)(3)

Transformation ... As iron and nickel alloys cool they separate into two components, kamacite, a low nickel alloy, and taenite, a high nickel alloy. The composition of these components depend upon the temperature at which they separate. Kamacite and taenite have different crystal structures, so when these alloys cool they pass from one phase to another; the change is called a transformation. (3)

Troilite ..... A sulfide of iron and a familiar mineral in all meteorites. Large masses of troilite occur in the iron meteorites. Troilite has a bronze yellow color, is often darkened by carbon, has a hardness of 4 and is easily attacked by acids. (2)(3)

Widmanstatten pattern ..... Some meteorites when etched show a pattern of kamacite lamellae intersecting in such a way that the lamellae are parallel to a face of an octahedron. This was first observed by Avois von Widmanstatten of Vienna while studying the Hraschine meteorite. (2)(3)

Zaratite ..... A hydrous nickel carbonate, a green secondary mineral found on some weathered meteorites and oxidized nickel bearing rocks.